ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

JULY 22, 1948

Steel frame is fitted to perimeter of Orange Bowl to carry increased seating capacity

IN THIS ISSUE:

SAND DRAINS STABILIZE HIGHWAY BED

TESTING NEW CANAL-LINING MATERIALS

Time out - - Bridge in

It took more than a pause to replace bridges in the old days. Then ARMCO Engineers developed MULTI-PLATE—a new type of construction that reduced the time element from weeks to days. It meant fewer detours, less cost and happier motorists.

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VOLUME 141 JULY 22, 1948 NUMBER 4

FEATURES IN THIS ISSUE

Enlarge Orange Bowl Stadium 48

Air System Shields Escalators from Fire 51

Sand Drains Stabilize Muck in Puerto Rico ..... J. C. CARPENTER 52

Thin-Shell Arch Hangars Span 257 Ft. ..... BOYD G. ANDERSON 55

Radio on the San Diego Aqueduct ..... R. D. THORSON 58

A New Concept of Water Chlorination ..... GORDON M. FAIR 60

Calcium Chloride Counteracts Impurities in Sand ..... I. LYSE 62

Foreign Languages ..... A. E. CUMMINGS 62

New Foundation for 350-Ton Crane ..... W. MACK ANGAS 63

Old Timber Bridges Decked With Concrete 68

Hotel Faced With Plastic and Aluminum 70

Test Linings Placed in Small Canals 74

Spiral Garage Enables High Space Use 78

DEPARTMENTS

Construction Trends 33

News of the Week 37

Editorials 46

Unit Prices 82

New Products 86

Elections and Activities 96

Manufacturers' Publications 98

Men and Jobs 105

Manufacturers' Activities 106

Construction Reports 133

Number of copies of this issue printed 43,876

Shall I use load tests?

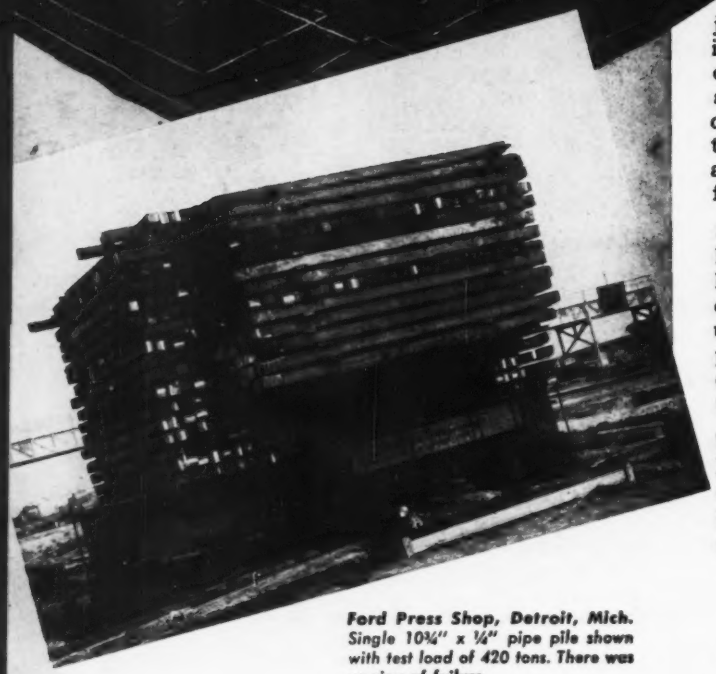
MORE and more engineers are recognizing the value of test piles and pile load tests. These tests afford the maximum assurance of foundation security and economy. There are three periods during which load tests are utilized:

1. **PRE-DESIGN LOAD TESTS** — Various types of piles are driven in sample areas of the site. The piles are then test-loaded and checked for settlement. In this way the type of foundation best suited to the conditions can be ascertained.

2. **PRE-CONSTRUCTION LOAD TESTS** — It is essential that these tests be made early in the job. The first step is to plot out the areas in the site in which the sub-soil characteristics are similar (as determined by soil borings). Then, one or more piles are driven and test-loaded before actual driving operations are started in each of these areas. Since the test loads usually exceed the loads the piles will actually have to carry by 150%-200%, the safety factor is established.

3. **POST-CONSTRUCTION LOAD TESTS**—Frequently load tests are made after work on the superstructure has started. It is advisable to point out the danger of this method. In the event that a load test proves unsatisfactory, it is too late to redesign the completed portion of the foundation. The great expense of rectifying such an error can be avoided through use of either of the above two methods.

WESTERN is equipped to furnish Pre-Design and Pre-Construction Load Tests. Make use of our **FREE CONSULTATION SERVICE** . . . the advice of our engineers in the pre-design stages frequently effects major savings. Write for Catalog A.



Ford Press Shop, Detroit, Mich. Single 10¾" x ¼" pipe pile shown with test load of 420 tons. There was no sign of failure.

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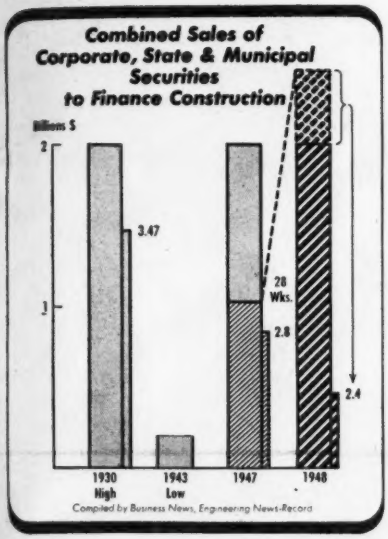
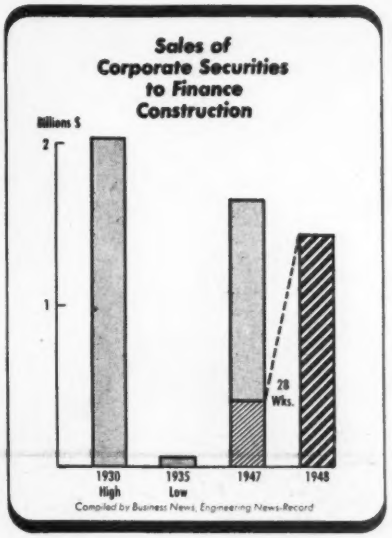
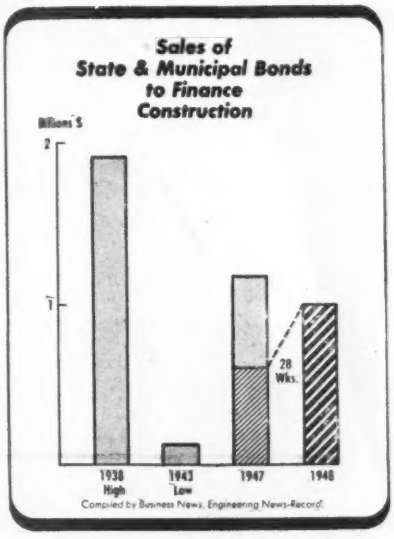
CONSTRUCTION TRENDS



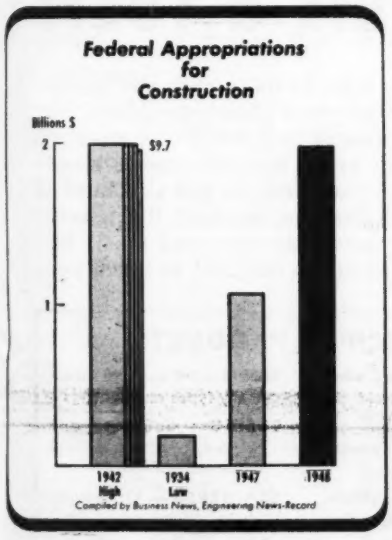
An all-time record is in the making for new construction capital raised through security sales. Through June 15, 1948, $2,428,000,000 in corporate securities and state and municipal bond sales for construction had been recorded by *Engineering News-Record* compared with $2,820,000,000 in 12 months of 1947 and $3,466,000,000 in 1930, the previous record year.



American industry has raised $1,429,000,000 for plant construction through June 15, of this year, by sale of corporate securities. This compares with $392,000,000 in the same period a year ago, $1,642,000,000 in 12 months of 1947 and $2,032,000,000 in the record year of 1930, as recorded by *Engineering News-Record*. A new record could be in the making.



State and municipal bond sales recorded by *Engineering News-Record*, total $999,000,000 through June 15, compared with $611,000,000 a year ago and $1,178,000,000 for all of 1947. The all-time record, set in 1938, is $1,902,000,000. Heavy municipal financing coincident with heavy corporate financing is the unusual situation prevailing this year.



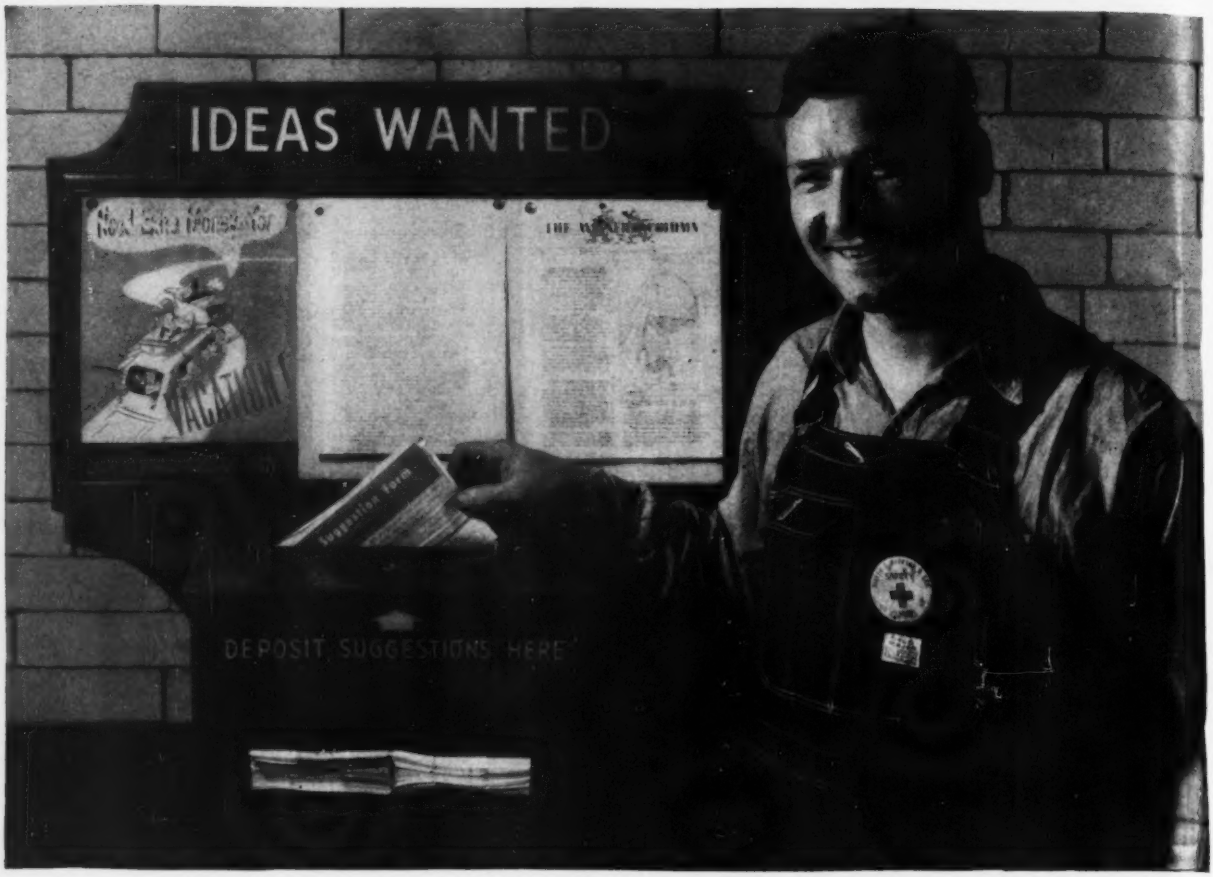
Federal appropriations total $1,986,220,877 including $435,000,000 in federal aid to states for highways and including $28,120,500 in deficiency appropriations. This compares with $1,066,000,000 last year, an increase of 86 percent. Increases are across the board except Atomic Energy which is $49 millions lower.

FEDERAL APPROPRIATIONS FOR CONSTRUCTION, FISCAL YEAR 1949

(Note: Contract Authorizations Not Included.)

Dept. of Agriculture	**$79,384,000**
Soil conservation service	45,084,000
Forest roads and trails.	15,050,000
Flood control	6,000,000
Water facilities	1,750,000
Emergency forest roads & trails (1)	11,500,000
District of Columbia	**17,721,283**
Atomic Energy Commission	**126,000,000**
Department of the Army.	**659,195,200**
Flood control	405,741,100
Rivers and harbors	166,989,100
Military construction	76,000,000
Panama Canal	100,000
Emergency flood control in northwest (1)	6,000,000
Misc. construction (2)	4,365,000
Housing and Home Finance Agency (emergency housing in northwest)	**10,000,000**
Tennessee Valley Authority	**15,142,000**
Department of the Navy—Bu. of Yards and Docks	**51,337,200**
Veterans Administration (hospital program)	**202,000,000**
Department of State—International Boundary and and Water Comm	**1,500,000**
Department of Justice (Federal Prison System)	**298,000**
National Advisory Committee for Aeronautics.	**10,000,000**
Department of Commerce.	**8,335,000**
Civil Aeronautics Admin. (Fed. aid airport program)	3,000,000
Civil Aeronautics Admin. (Alaska airports) (1)	3,500,000
Washington National Airport	1,835,000
Federal Security Agency	**45,507,240**
U. S. Public Health Service (hospital program)	40,000,000
U. S. Public Health Service (researeh facilities)	5,000,000
Howard University	507,240
Federal Works Agency	**440,080,104**
Public Roads Adm.	435,658,854
Public Buildings Adm.	3,525,000
Bureau of community facilities	896,250
Department of Interior	**319,720,850**
Bureau of Reclamation (4)	232,609,500
Territory of Alaska (5)	34,912,400
Bonneville Power Administration (6)	18,428,900
Geological Survey (7).	10,956,700
Bureau of Mines	10,200,000
Bureau of Indian Affairs (8)	7,841,000
National Park Service.	4,762,350
Total for construction	**$1,986,220,877**

(1) From 1948 2nd Deficiency Act.
(2) From 1948 1st Deficiency Act.
(3) Includes $2,925,000 from 1948 Deficiency Acts.
(4) Includes $5,609,500 from 1948 1st deficiency.
(5) Includes $7,370,000 from 1948 1st deficiency.
(6) Includes $525,000 from 1948 1st deficiency.
(7) Includes $485,000 from 1948 1st deficiency.
(8) Includes $841,000 from 1948 1st deficiency.



A Thousand Improvements a Year!

We at Ryerson believe that constant improvement in every operation is the key to good steel-service. We continually invent, revamp, revise, reorganize—*improve*. Best of all, our employees help show us the way.

Last year, for instance, our employees submitted a total of 3,686 suggestions, each of which described a procedure, policy or piece of equipment designed to improve the efficiency of our steel service. Of the 3,686 ideas, 1,379 proved worthy of cash awards and are now being used to the ultimate benefit of Ryerson customers. Accepted suggestions ranged from a method of speeding the paper work in processing an order to more accurate gauges for our biggest friction saws.

This willingness of our entire organization to help achieve maximum efficiency is one reason we are able to promise you a steel-service that's intelligent, ever alert to do the job still better. Encouraged to advance their own ideas, our employees often assist in determining practical alternates when great demand causes shortages of the steel you need. To put this kind of service to work for you, contact the nearest Ryerson plant next time you need steel. You can be sure we shall do our best to serve you.

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'48 Construction Sets Peacetime Record

Heavy engineering construction at the end of the first six months of 1948 is running 25 percent ahead of a year ago. Contracts awarded through June this year, as recorded by *Engineering News-Record*, total $3,333,369,000 compared with $2,673,865,000 for half of 1947.

Public contract awards for the first half of 1948 rose 51 percent above the 1947 six-months total while private contracts rose 5 percent. In the several classified construction groups listed below, public buildings showed the greatest gain rising to $509,416,000, or more than double the corresponding 1947 total of $252,419,000.

All other groups, with the exception of unclassified construction, showed gains over 1947 ranging from 78 percent for bridges down to 6 percent for commercial buildings. Unclassified construction declined 38 percent from 1947 to 1948, but is still 26 percent above the corresponding six-months total for 1946.

Geographically, all sections of the United States so far this year are running ahead of the cumulative totals for the first half of 1947. The Middle Atlantic states showed the greatest gain, 43 percent, with the New England states following a close second with a gain of 42 percent. Far West showed the smallest gain, only 3 percent.

In thirty-four of the individual states the dollar volume of contract awards exceeded the 1947 totals. Montana showed a gain of 1,058 percent; Maryland, Delaware, Nebraska, Idaho and Nevada were over triple the 1946 volume; and New Hampshire, Massachusetts, Alabama, Louisiana, Iowa, North Dakota and Utah more than doubled last year's six-months volumes.

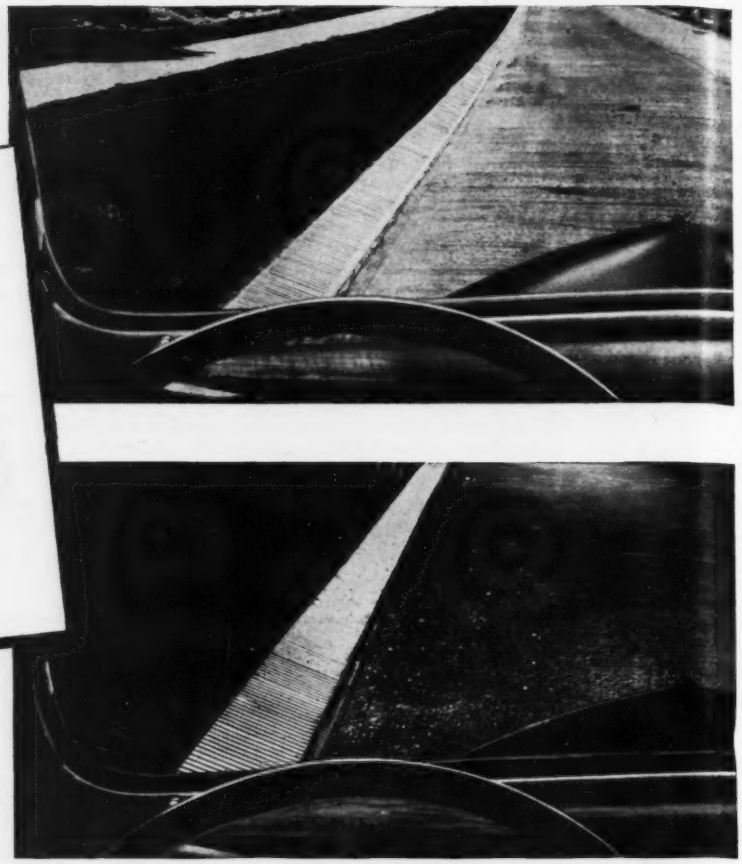
Although *Engineering News-Record's* backlog of proposed construction continued to rise to $42,191,071,000 at the end of June from the June 1947 total of $39,533,839,000, additions to the backlog of $1,212,542,000 from January through June declined 70 percent below the corresponding 1947 additions of $3,976,387,000.

ENGINEERING CONSTRUCTION REPORTED BY ENGINEERING NEWS-RECORD—FIRST HALF 1948

Minimum contracts reported: Waterworks, excavation, drainage and irrigation, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.
(Thousands of Dollars—000 omitted)

States	PUBLIC WORKS CONTRACTS					BUILDINGS				Federal Gov't. Work	All Construction		1948 Total 26 Weeks	1947 Total 26 Weeks	% Change 1947 to 1948
	Water-works	Sewer-age	Bridges	Earthwork Irr.-Drain.	Streets, Roads	Industrial	Commer-cial	Public	Un-classified		Private	Public			
Maine	.....	.....	1,899	.....	1,332	.....	.....	.....	150	.....	150	3,231	3,381	15,764	− 79
New Hampshire	.....	.....	430	1,224	885	.....	.....	.....	.....	1,278	.....	2,539	2,539	901	+182
Vermont	.....	.....	94	.....	729	.....	.....	1,139	174	94	.....	2,136	2,136	2,281	− 6
Massachusetts	9,588	964	14,702	309	6,243	992	11,663	1,082	7,484	886	12,850	40,177	53,027	19,749	+169
Rhode Island	.....	783	53	96	2,213	1,125	6,265	3,040	733	679	7,940	6,368	14,308	13,176	+ 9
Connecticut	572	1,178	1,672	1,888	6,558	19,209	30,248	10,896	572	2,977	49,579	23,214	72,793	52,598	+ 38
New England	**10,160**	**2,925**	**18,850**	**3,517**	**17,960**	**21,326**	**48,176**	**16,157**	**9,113**	**5,914**	**70,519**	**77,665**	**148,184**	**104,469**	**+ 42**
New York	27,335	7,010	4,754	23,000	19,701	11,091	119,580	44,054	7,296	37,962	131,151	132,670	263,821	204,109	+ 29
New Jersey	477	998	7,823	1,852	6,213	17,586	54,423	20,460	1,353	15,341	73,454	37,731	111,185	87,530	+ 27
Pennsylvania	5,792	3,063	13,700	17,024	58,215	32,245	192,656	45,811	7,908	51,809	225,643	150,771	376,414	307,206	+ 23
Maryland	1,557	497	8,849	924	14,569	10,259	69,428	10,799	4,314	3,192	79,987	41,209	121,196	35,897	+238
D.C.	589	1,064	2,756	.....	616	510	2,950	7,006	535	1,167	3,460	12,566	16,026	15,012	+ 7
Delaware	.....	.....	5,700	155	3,605	30,550	14,030	7,479	35	7,302	44,615	16,939	61,554	16,878	+265
Middle Atlantic	**35,750**	**12,632**	**43,582**	**42,955**	**102,919**	**102,241**	**453,067**	**135,609**	**21,441**	**116,773**	**558,310**	**391,886**	**950,196**	**666,632**	**+ 43**
Virginia	1,868	1,006	2,290	16,481	5,484	2,094	12,044	6,341	4,264	21,498	14,679	37,193	51,872	45,944	+ 13
West Virginia	.....	.....	712	57	3,808	1,562	1,615	10,792	7,964	10,791	10,877	15,633	26,510	22,646	+ 17
North Carolina	2,180	3,021	2,135	477	11,366	5,193	6,268	2,699	2,097	1,142	12,434	23,002	35,436	37,923	− 7
South Carolina	514	814	869	253	9,404	4,111	8,609	1,879	1,423	259	13,658	14,218	27,876	27,323	+ 2
Georgia	1,824	1,007	554	1,272	15,753	10,543	16,196	5,163	4,983	1,414	30,248	27,047	57,295	49,917	+ 15
Florida	3,151	2,237	7,026	1,421	4,512	11,256	31,624	6,366	9,002	5,078	49,120	27,475	76,595	90,997	− 16
Alabama	556	3,391	875	233	6,166	52,013	5,624	5,705	5,403	1,106	61,208	18,758	79,966	35,685	+124
Mississippi	932	543	174	1,047	10,542	1,206	1,327	6,908	2,575	1,810	4,160	21,094	25,254	37,694	− 33
Louisiana	1,052	7,628	4,644	10,427	9,588	3,885	19,165	17,130	2,082	9,926	24,753	50,848	75,601	28,794	+163
Kentucky	1,145	2,015	2,418	4,452	4,775	4,322	2,722	2,476	4,217	5,827	10,022	18,520	28,542	48,693	− 41
Tennessee	1,675	276	1,910	1,945	20,351	3,171	6,803	17,156	13,870	13,530	22,663	44,494	67,157	41,693	+ 61
Southern	**14,897**	**21,938**	**23,607**	**38,065**	**101,749**	**99,356**	**111,997**	**82,615**	**57,880**	**72,381**	**253,822**	**298,282**	**552,104**	**467,309**	**+ 18**
Ohio	4,022	1,369	2,339	1,455	17,458	42,347	23,814	16,220	6,067	4,618	68,665	46,426	115,091	82,523	+ 39
Indiana	825	723	2,902	941	4,819	11,082	5,350	14,463	4,184	7,419	19,689	25,600	45,289	26,114	+ 73
Illinois	3,168	9,311	4,956	3,993	18,672	52,155	14,660	11,926	5,957	5,654	69,810	54,988	124,798	136,335	− 8
Wisconsin	1,275	2,718	3,209	.....	22,854	8,514	5,876	7,643	2,579	.....	15,887	38,781	54,668	56,389	− 3
Michigan	1,198	407	3,261	.....	9,241	5,147	500	17,660	842	10,981	6,372	31,884	38,256	51,153	− 25
Middle West	**10,488**	**14,528**	**16,667**	**6,389**	**73,044**	**119,245**	**50,200**	**67,912**	**19,629**	**28,672**	**180,423**	**197,679**	**378,102**	**352,514**	**+ 7**
Minnesota	932	1,533	1,041	680	10,626	3,705	4,953	3,881	2,486	1,202	10,303	19,534	29,837	28,811	+ 4
Iowa	2,332	1,024	3,972	2,860	12,544	8,140	6,340	8,200	2,623	3,169	15,901	32,134	48,035	23,652	+103
Missouri	1,770	2,273	3,323	4,522	7,663	8,803	20,889	12,613	6,508	14,781	35,766	32,597	68,363	43,456	+ 57
Arkansas	358	170	1,272	5,656	699	5,206	500	11,864	2,558	17,440	6,891	21,392	28,283	57,945	− 51
North Dakota	796	527	57	4,147	6,777	1,260	.....	1,714	1,093	5,532	2,077	14,294	16,371	6,911	+137
South Dakota	101	334	681	4,935	5,599	200	.....	1,888	1,788	6,687	1,507	14,019	15,526	11,237	+ 38
Nebraska	115	956	.....	26,863	8,509	1,528	1,833	12,542	4,140	37,891	6,213	50,273	56,486	16,924	+234
Kansas	702	808	839	2,800	12,549	7,317	11,044	2,188	7,946	3,138	25,533	29,660	41,993	52,474	− 20
Oklahoma	731	2,819	1,625	6,067	6,846	6,301	2,839	7,481	8,069	7,892	16,425	26,353	38,578	28,647	+ 35
Texas	7,003	7,532	4,598	25,687	32,218	56,468	127,078	40,766	43,238	39,046	213,059	131,529	352,988	274,302	+ 29
Montana	110	485	554	56,266	4,206	75	3,452	6,474	1,082	60,762	4,816	67,888	72,704	6,277	+1,058
Wyoming	648	270	.....	1,117	2,950	.....	700	410	3,085	2,813	3,023	6,157	9,180	19,455	− 53
Colorado	397	262	1,191	654	5,791	15,850	1,872	1,405	3,143	3,307	18,832	11,733	30,565	28,088	+ 9
New Mexico	132	95	.....	368	6,051	428	815	5,721	2,071	6,115	3,014	12,667	15,681	18,564	− 16
West of the Miss.	**16,127**	**19,088**	**19,153**	**142,622**	**123,028**	**115,281**	**182,314**	**117,147**	**89,830**	**289,775**	**363,360**	**461,230**	**824,590**	**616,743**	**+ 34**
Idaho	.....	161	352	3,157	3,109	12,820	849	1,458	571	4,426	14,176	8,301	22,477	7,101	+217
Utah	587	230	140	929	1,753	9,078	4,850	3,158	2,285	2,130	14,365	8,645	23,010	7,972	+189
Arizona	72	.....	1,035	1,866	4,364	.....	945	518	4,640	6,733	945	12,495	13,440	7,357	+ 83
Nevada	511	150	191	1,637	2,961	.....	.....	1,684	1,407	4,093	.....	8,541	8,541	2,578	+231
Washington	1,053	3,220	13,005	4,288	9,548	7,656	20,447	43,110	6,680	36,778	30,124	78,883	109,007	75,334	+ 45
Oregon	468	2,201	2,096	3,881	6,511	2,780	7,824	9,180	2,709	10,176	11,628	26,022	37,650	34,278	+ 10
California	8,350	25,684	7,160	23,144	32,638	31,381	83,992	30,868	22,851	29,312	126,698	139,370	266,068	331,578	− 20
Far West	**11,041**	**31,646**	**23,979**	**38,902**	**60,884**	**63,715**	**118,907**	**89,976**	**41,143**	**93,648**	**197,936**	**282,257**	**480,193**	**466,198**	**+ 3**
U.S. 1948 (Thru. June)	**98,463**	**102,757**	**145,838**	**272,450**	**479,584**	**521,164**	**964,661**	**509,416**	**239,036**	**527,163**	**1,624,370**	**1,708,999**	**3,333,369**	.....	.....
U.S. 1947 (Thru. June)	55,627	64,171	81,786	156,940	378,185	388,629	912,168	252,419	383,940	331,938	1,542,435	1,131,430	.....	2,673,865	.....
% Change '47 to '48	+77	+60	+78	+74	+27	+34	+6	+102	−38	+59	+5	+51	.....	.....	+ 25
Canada, 1948	**2,014**	**6,012**	**1,483**	**2,302**	**16,585**	**36,869**	**19,671**	**45,302**	**60,929**	.....	**168,020**	**83,147**	**191,167**	.....	− 13
Canada, 1947	622	188	308	358	11,256	11,722	6,665	10,805	3,422	.....	19,597	25,749	.....	218,616	.....

WHITE
BY DAY...
WHITER
BY NIGHT...



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ATLAS WHITE REFLECTING CURB

Better highway visibility around the clock promotes greater highway safety. White Concrete Reflecting Curb, made with Atlas White Cement, clearly defines the road's edge by day and reflects an even clearer ribbon of light at night.

By night the saw-tooth faces of Atlas White Reflecting Curb catch headlight rays and reflect them back to the driver. On rainy nights, the reflecting surfaces become even more mirror-like. The curb is actually more visible when highways are wet and more dangerous!

Send for full details. *Write to Atlas White Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.*

A smooth curb wastes the car's headlights. It deflects light away from the driver. Edge of road is difficult to see. Driving dangers are increased.

White Concrete Reflecting Curb uses the car's headlights. Saw-tooth faces mirror the light back to the driver; form a continuous, bright ribbon of light at the road's edge. Driving is safer.

ENR-RM-54

ATLAS WHITE CEMENT
For White Concrete Reflecting Curb

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—September to June—ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • JULY 22, 1948 • VOLUME 141 • NUMBER 4

Steel warns of price rise as base-point action continues

U. S. Steel, granting wage increase, plans raising prices at mills—Federal Trade Commission starts action against paint-pigment manufacturers

The double impact of a third-round wage boost to steel workers and the abandonment of the basing-point pricing system started to push construction steel prices upward last week.

The upward trend of steel prices was a close parallel with that of cement (*ENR* July 15, p. 1).

A second parallel—and what Washington observers thought was an indicator of how far the Federal Trade Commission might consider pushing its actions under the Supreme Court's decision against the cement industry's basing-point system—was an FTC action against the National Lead Company and a half-dozen producers of white lead and other pigments for paint manufacture.

By the end of last week, most large steelmakers had announced that they were off the basing-point pricing system, but the accompanying lists of prices for various steel items showed no changes in f.o.b. prices at the various mills. Buyers located at some distance from the mills will pay more than they previously did, while buyers close to the plants may pay less.

Pay rise sparks price rise

The second factor in the steel price picture was U. S. Steel's announcement last week that it had granted a third wage increase to its thousands of workers. The increase—amounting to about 13 cents an hour, or nine percent—marked the end of an effort by the company to hold down the cost of living that started last April with a reduction in price on some steel items and the company's refusal to grant a wage increase to its workers.

But payment of higher wages—coupled with generally higher costs for materials—will force a rise in the price of steel, Benjamin F. Fairless, company president, warned. "The steel producing subsidiaries of United States Steel will soon announce increases in their prices for various steel products at their mills or shipping points, following completion on cost studies now being made," Mr. Fairless said. He emphasized that this action is "not occasioned to the slightest extent" by the abandonment of the basing-point system.

Most other major steel producers followed the U. S. Steel lead with announcements at week's end that prices on some items would be increased.

An indicator of the FTC attitude on basing-point practices was seen in the government brief filed in the action against the pigment manufacturers.

In their brief, FTC lawyers reiterated that they believed delivered pricing is illegal only if the commodity is: (1) Standardized, with little quality difference between the product of one seller and another; (2) so heavy that freight charges are an important part of the final cost of the product to the buyer.

Speaking of the scope of the cement decision, FTC lawyers said: "Arguments will no doubt be advanced that (the cement institute) decision would necessarily result in condemning any universal delivered price system in any industry. . . applicable . . . to chewing gum, candy, magazines . . . which are sold on a universal price. Such argument is without foundation."

The legal experts agreed that banning the universal delivered price system "would be entirely inapplicable to any industry or product where transportation would not affect competition in a substantial manner."

The FTC has charged that in the lead industry, systematic freight absorption and phantom freight involved in the zone delivered pricing system resulted in no competition and price discrimination against near-the-mill buyers. An FTC trial examiner had previously found that in the pigment industry use of a delivered price within a zone did not discriminate against buyers within that zone. However, the examiner found that different prices for different zones did result in price discrimination.

CAA to level airport obstructions

A new law passed quietly in the final days of the recent session of Congress and signed early this month by the President, gives the Civil Aeronautics Administration power to buy, or acquire through condemnation, lands around certain airports where necessary to remove obstructions to air navigation.

The law applies to air-space around fields owned by CAA and those on which the agency operates federally-owned air navigation facilities. CAA has but one airport at present (National Airport, Washington, D. C.), but it operates U. S.-owned navigation aids at nearly 100 other flying terminals and is installing more.

Almost the only restriction on CAA's powers to take over property is the restriction that it shall do so only to the extent funds are available for the purpose. The agency has little money under its present budget which by any stretching of the language of its appropriation act could be used for buying property. It almost certainly will ask Congress later for such funds. Meanwhile, it conceivably may start condemnation proceedings anywhere it finds an objectionable construction project, in the hope that necessary funds will be forthcoming before the case is decided. Such a step would stop work on the offending structure, at least during the condemnation proceedings.

The airlines, in order to compete with other carriers, must schedule regular flights in and out of their terminals. That means all-weather flying—a goal that now seems just around the corner.

During the war the services per-

(*Continued on page* 41)

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Public construction — New bids were taken on July 21 for the Central Schuylkill pumping station and siphon by the *Philadelphia* department of public works. Previous bids—the low of which was $1,149,200—were rejected. . . . *Clay County, Ill.*, has begun a new $1,000,000 hospital. . . . Funds are sought for a $2,162,000 hospital at *Danville, Va.*

Housing—Douglaston Terrace, residential section of *Queens County, N. Y.*, will be enlarged by 150 new single-family dwelling units. The project, soon to begin, will cost an estimated $2,000,000. . . . *Pennsylvania* authorities are exploring the possibility of buying ready-built homes close to state hospitals to provide housing for mental institution doctors and other hospital personnel.

Labor—*Dayton, O.*, bricklayers received a 30-cent hourly increase and ended a 70-day strike . . . Pipefitters in *St. Paul* and *Minneapolis*, have been granted a 25-cent hourly wage increase, retroactive to May 3; overtime was cut from double to time and a half. . . . *Twin Cities* carpenters also won a 25-cent an hour increase. . . . *Rochester, N. Y.*, contractors have asked a state survey of building trade mechanics, blaming labor shortages for costs and delays. . . . Truck drivers of *Buffalo, N. Y.*, have recently agreed to a 15-cent hourly pay boost.

Industrial construction — Engineering work has begun on a $2,000,000 steam-electric generating plant for the Rural Cooperative Power Association, of *Maple Lake, Minn.* . . . A $1,000,000 dairy plant is planned for *Philadelphia, Pa.* . . . *Coronado, Calif.*, plans a $3,500,000 resort hotel—the local zoning commission permitting. . . . A new 220-room hotel at *Miami Beach, Fla.*, is scheduled to open sometime early next winter.

Water supply and sewers — Revenue bonds for $6,000,000 worth of water line improvements are to be issued by the city of *San Diego, Calif.* Funds would allow $1,500,000 for completion of Alvardo treatment plant. . . . *South Bend, Ind.*, plans a two-year expansion program costing $900,000 for its water system. . . . Construction plans for an $11,500,000 sewer system for *Tampa, Fla.*, are in the making. . . . City authorities of *St. Petersburg, Fla.*, have voted "immediate action" on proposed sewer extensions costing an estimated $9,000,000. . . . Storm sewers required by a proposed truck by-pass at *Billings, Mont.*, have been authorized. . . . *North Dakota* cities in the upper Red River valley saw the start of a $12,500,000 water supply project. . . . Authorization has been received for $3,000,000 worth of revetment work on the Missouri River in *South Dakota*.

Highways—A toll bridge costing about $1,500,000 is planned to cross the Wabash River at *St. Francisville, Ill.* . . . *New Jersey's* State Highway Department placed road and bridge work totaling $30,436,749 under contract in the year ending July 1. . . . Grading on the superhighway connecting *Fort Meade, Md.*, to *Washington, D. C.*, is over one-third complete. . . . PRA approval is sought for 16 hignway and bridge projects in *Washington, D. C.*, for the next two years. . . . *Maryland's* highway expenditures in 1948 are expected to approach $50,000,000. . . . *South Dakota* is employing 187 mechanical traffic counters in an extensive survey. . . . Motor vehicle receipts of $2,288,750 have been apportioned within the *New Jersey* highway department. . . . *Kentucky* has let contracts for resurfacing totaling $1,119,680.

National Society aims at professional recognition

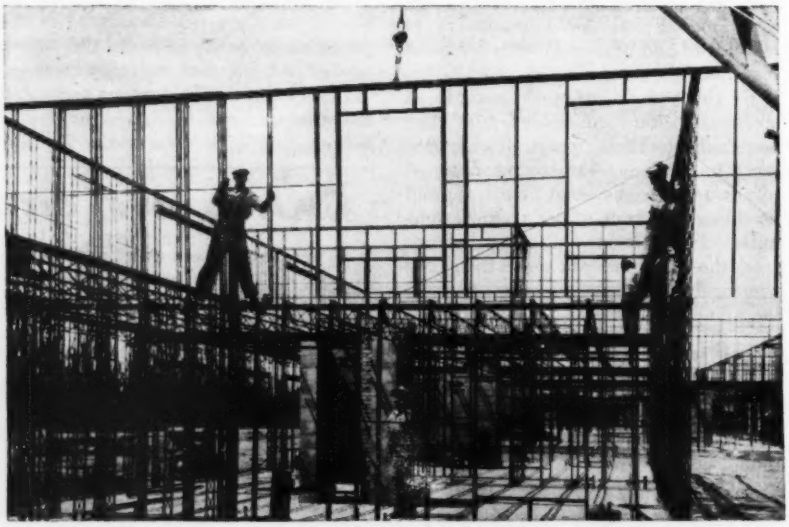
Professional recognition and stature for engineers, comparable with other professions, is the aim of the National Society of Professional Engineers, Alex Van Praag, Jr., Decatur, Ill., society president, said at a recent Arkansas section meeting.

Recommendations of the Arkansas Society include an increase from four to "five or more years" in college engineering courses and employment of only registered engineers in engineering positions.

North Carolina warns unlicensed contractors

Unlicensed contractors in North Carolina have been warned to stop work in which they are engaged until they obtain licenses, according to J. M. Wells, Jr., of Raleigh, secretary-treasurer of the North Carolina Licensing Board for Contractors.

Mr. Wells pointed out that the North Carolina law requires contractors on all projects costing $10,000 or more to be licensed by the board. He said that many of the contractors, engaged on small housing projects, are unaware of the law, and most of them have been "very cooperative" when informed that they are in violation.



WELDED HOUSING—The Schroedel Construction Co. of Milwaukee, Wis., claims a direct saving of about 50 percent over masonry and fire-resistive construction in a group of four 12-family apartments now under construction at Shorewood, Wis. Steel wall frames and floor joists are used; wall panels prefabricated in the shop with arc welding techniques; and panels were erected in the field also by arc welding. A modular design of two-foot increments permitted the controlled shop fabrication of first and second-floor panels. Open-web expanded steel studs were welded between a channel cap and a sill plate. Three-quarter inch channel was added between studs for horizontal bracing.

Federal road funds become available for state commitment by Sept. 1.

Funds for fiscal year 1950 to be apportioned under new act to give states 34 months to obligate expenditures

Federal-aid highway funds for fiscal year 1950 will become available for commitment by the states within six weeks.

A special provision of the Federal-Aid Highway Act of 1948 requires apportionment among the states by Sept. 1, 1948, of the $450,000,000 for fiscal 1950.

Once the money is apportioned, it becomes an obligation of the federal government to make good on the sums alloted.

Apportionment is based on area, population (total or rural) and post-road mileage, and the final figures cannot be determined until the postmaster general supplies the current mileage of mail routes for each state.

Approximate distribution of the fiscal 1950 funds appears in an accompanying table. The figures shown there are extremely close to the final figures. It will be noted that the money is distributed 45 percent for the federal-aid primary system, 30 percent for secondary and 25 percent for urban, as stipulated by the 1948 highway act.

This distribution is the same as in the preceding 1944 federal-aid highway law. The new law also continues the requirement that the federal funds be matched dollar for dollar by the participating states.

Previous federal-aid highway acts required apportionment by Jan. 1 preceding the beginning of the fiscal year. That gave the states use of the money six months in advance of the fiscal date. The new law increases this prior period to ten months. With a prescribed grace period of twelve months following the fiscal year, the 1948 act thus gives the states a total of 34 months in which to obligate the apportioned money.

Previous obligations

To cover its previous obligations under the 1944 highway act, Congress in May appropriated $427,000,000 for federal aid. At the beginning of fiscal 1949, there were available from authorized funds of the 1944 act $190,000,000 in unprogrammed money and $358,000,000 in programmed projects, accepted and obligated by the Public Roads administration and ready for approval of plans in the PRA district offices.

Signing of the 1948 act on June 29 released some money retained by PRA out of the $500,000,000 federal-aid authorization for fiscal 1948. When the apportionment to the states was made in May, 1947 (for fiscal 1948) PRA held on to 5 percent to take care of any change Congress might make in the allowance for administrative expense.

This allowance was set by the new highway act at 3¾ percent, an increase over the previous 2½ percent rate to take care of higher costs. The PRA thereupon deducted the 3¾ percent from the 5 percent withheld and apportioned the remaining 1¼ percent, or $6,250,000, among the states.

Soon afterwards, PRA also apportioned the $20,000,000 for forest highways in fiscal 1950 as authorized by the 1948 act. The forest highway apportionments vary widely—as determined by area and value of national forests—from $83 in North Dakota to $2,845,848 in California. Forest highway allocations are in addition to the sums shown in the accompanying table. Under present interpretation of the law, PRA will undertake no obligations for actual construction of forest highway projects in fiscal 1950 until Congress has appropriated the authorized money.

APPROXIMATE APPORTIONMENT OF $450,000,000 FEDERAL-AID HIGHWAY PROGRAM FOR FISCAL 1950.

State	Federal-Aid Primary ($202,500,000)	Federal-Aid Secondary ($135,000,000)	Federal-Aid Urban ($112,500,000)	Total ($450,000,000)
Alabama	$4,215,000	$3,335,000	$1,158,000	$8,708,000
Arizona	2,885,000	1,995,000	233,000	5,113,000
Arkansas	3,442,000	2,769,000	496,000	6,707,000
California	7,997,000	4,576,000	7,216,000	19,789,000
Colorado	3,585,000	2,412,000	829,000	6,826,000
Connecticut	1,242,000	682,000	2,317,000	4,241,000
Delaware	974,000	650,000	181,000	1,805,000
Florida	2,885,000	1,932,000	1,421,000	6,238,000
Georgia	5,014,000	3,826,000	1,441,000	10,281,000
Idaho	2,475,000	1,731,000	188,000	4,394,000
Illinois	7,830,000	4,210,000	8,450,000	20,490,000
Indiana	4,784,000	3,208,000	2,724,000	10,716,000
Iowa	4,924,000	3,521,000	1,415,000	9,860,000
Kansas	4,987,000	3,502,000	984,000	9,473,000
Kentucky	3,755,000	3,039,000	1,155,000	7,949,000
Louisiana	3,029,000	2,265,000	1,361,000	6,655,000
Maine	1,728,000	1,245,000	498,000	3,471,000
Maryland	1,631,000	1,043,000	1,590,000	4,264,000
Massachusetts	2,613,000	698,000	5,875,000	9,186,000
Michigan	6,067,000	3,670,000	5,049,000	14,786,000
Minnesota	5,363,000	3,695,000	1,960,000	11,018,000
Mississippi	3,621,000	2,983,000	533,000	7,137,000
Missouri	5,909,000	4,048,000	2,800,000	12,757,000
Montana	4,036,000	2,757,000	273,000	7,066,000
Nebraska	3,969,000	2,802,000	695,000	7,466,000
Nevada	2,547,000	1,707,000	54,000	4,308,000
New Hampshire	975,000	650,000	422,000	2,047,000
New Jersey	2,541,000	923,000	4,911,000	8,375,000
New Mexico	3,232,000	2,237,000	229,000	5,698,000
New York	9,612,000	3,787,000	16,682,000	30,081,000
North Carolina	4,843,000	3,967,000	1,326,000	10,136,000
North Dakota	2,961,000	2,134,000	191,000	5,286,000
Ohio	6,982,000	4,111,000	6,699,000	17,792,000
Oklahoma	4,502,000	3,306,000	1,198,000	9,006,000
Oregon	3,330,000	2,272,000	720,000	6,322,000
Pennsylvania	8,166,000	4,686,000	9,344,000	22,196,000
Rhode Island	975,000	650,000	998,000	2,623,000
South Carolina	2,717,000	2,242,000	581,000	5,540,000
South Dakota	3,129,000	2,228,000	197,000	5,554,000
Tennessee	4,258,000	3,273,000	1,415,000	8,946,000
Texas	12,693,000	8,940,000	3,966,000	25,599,000
Utah	2,264,000	1,507,000	385,000	4,156,000
Vermont	975,000	650,000	188,000	1,813,000
Virginia	3,656,000	2,836,000	1,325,000	7,817,000
Washington	3,142,000	2,128,000	1,304,000	6,574,000
West Virginia	2,210,000	1,856,000	718,000	4,784,000
Wisconsin	4,823,000	3,267,000	2,358,000	10,448,000
Wyoming	2,477,000	1,681,000	118,000	4,276,000
Hawaii	975,000	650,000	350,000	1,975,000
District of Columbia	975,000	650,000	1,019,000	2,644,000
Puerto Rico	986,000	1,006,000	741,000	2,733,000

Mile of pavement laid as single day's work

The Public Works Department of New York State believes a new highway construction record may have been set in June when workmen laid more than a mile of concrete pavement in one day.

A crew of Arute Brothers, Inc., New Britain, Conn., poured 5,799 feet of reinforced concrete, 12 ft. wide and 8 in. thick, on Route 20 between Morrisville and Cazenovia.

Wage-hour administrator defines legal overtime

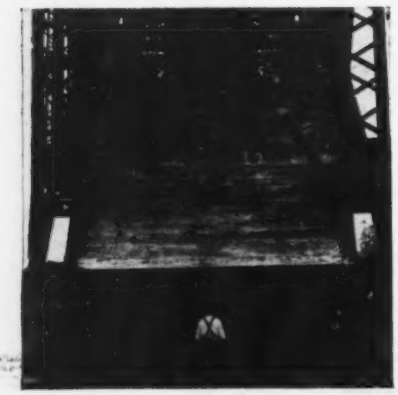
Premium pay for work at undesirable hours, even though it may be time and a half, is not real overtime pay as required by the wage-hour law, William R. McComb, wage hour administrator, said last week. Such extra payments cannot be offset against legal overtime and must be included in the "regular rate" on which the time and a half overtime is figured.

This clarification of a Supreme Court decision is of particular importance to those contractors in the building and construction industry who come under the wage-hour law and pay time and a half for any work outside the eight to four daytime shift.

McComb's new interpretation of the wage-hour requirements, which may be relied on in "good faith" by employers under the portal-pay law, stems from the Supreme Court decision in the stevedoring cases last June 7. In those cases, the court held that the time and a half paid stevedores for work done after 5 p. m. was a penalty time for working undesirable hours, and not overtime.

Real overtime, the court said, can come only after an employee has worked a standard number of hours or days.

Enforcement of these new principles will begin Sept. 15. Answers to specific problems will be given by McComb when requested in writing.



BAD SEAT — The 1,500-ton counterbalance on a Great Northern Railway bridge over the Lake Washington Ship Canal near Seattle, Wash., came to rest on the tracks in a freak accident. Steel girders holding the weight failed as the 200-ft. bascule span was raised. Nomally, when the span is open the counterbalance remains 12 to 15 in. above the roadbed. Railroad engineers said they would have to chip the concrete counterbalance away with jackhammers while the span is held in nearly vertical position.

NLRB examiner drops union boycott charge

The National Labor Relations Board disagrees with the view that the AFL Building and Construction Trades Council in Grand Rapids, Mich., must rescind rules in its constitution which conflict with the Taft-Hartley Law. The reason: the rules have not been invoked since the law became effective.

The council has been under injunction since June 23 against the continuation of an unfair labor practice—a secondary boycott against Osterink Construction Co. They are accused of violating the Taft-Hartley Law by inducing two bricklayers employed by the Grand Rapids Tile and Mosaic Co. to quit tile and terrazzo work on the Grand Rapids Christian High School in an effort to compel the tile firm to stop doing business with Osterink, from which it subcontracted the work.

The trial examiner, William F. Scharnikow, who held hearings on the unfair labor practice charge, recommended to the board that the local union and its president-business agent be held guilty of a secondary boycott, and urged that the council be held innocent.

In recommending dismissal of the charge against the council, which had listed the job as "unfair," Scharnikow pointed out that the council's constitution does not impose penalties against union members for not observing the "unfair" listing and does not provide for mandatory enforcement. No enforcement orders have been issued since the Taft-Hartley Law became effective, the trial examiner said.

New director chosen for Delaware bridge

W. W. Mack, former chief engineer of the Delaware State Highway Department and more recently consulting engineer for the department, has been appointed director of the Delaware crossing division. He will direct work on the new $40,000,000 Delaware River Memorial Bridge near Wilmington, Del. (*ENR* June 17, vol. p. 985).

Mr. Mack succeeds Lieut.-Gen. Eugene Reybold (USA retired), who recently joined Lustron Corp. as vice-president in charge of operations.

Homer R. Seeley, for the past eight years deputy commissioner of public works for New York City, will be the project engineer for the Delaware River Memorial Bridge, representing the consulting engineers, Howard, Needles, Tammen and Bergendoff.

Begin master plan for Oak Ridge plant

Development of a master plan for the Oak Ridge National Laboratory at Oak Ridge, Tenn., got under way last week when the Austin Co., Cleveland architect-engineer-construction firm, started work under a contract with the Atomic Energy Commission.

No construction work is included in the contract. The contractor will prepare detailed drawings and specifications for a number of individual facilities and will furnish engineering supervision of construction operations when a building contract is let. Cost estimates and other data necessary for construction scheduling will be developed in conjunction with the master plan.

In general, the master plan will include permanent laboratory facilities for the physics, chemistry and other technical divisions, and administrative offices and service buildings such as warehouses, shops, cafeteria and laundry. The planners will try to utilize existing facilities so far as practicable.

Some permanent construction has been done at Oak Ridge. This work includes a steam power plant and a high-voltage power line and sub-station.

ONE BID ON GARRISON DAM

Army engineers received only one bid on excavation and main embankment, stage two for construction of huge Garrison Dam near Bismark, N. D.—and that bid was far over the engineer's estimate.

The lone bid, submitted by Dakota Constructors, was $58,768,000 compared to an engineer's estimate of $35,000,000.

Dakota Constructors is a combination of Wright Contracting Co., Peabody, Mass.; J. A. Jones Const. Co., Charlotte, N. C.; Charles H. Tompkins Co., Washington, D. C.; Wunderlich, Brown and Western, Inc., St. Paul, Minn.; and Hooper Const. Co. and Oman Const. Co., Nashville, Tenn.

Seminar conducted by Public Health Service

The U. S. Public Health Service is holding its fourth and final seminar in Washington July 12-30 to educate architects, engineers and hospital administrators in the operation of the federal-aid hospital program. Attendance at the daily sessions averages 50 persons.

The staff of the Division of Hospital Facilities acts as the faculty for the seminar. At the sessions, the staff and the entire group discuss administrative problems, technical subjects and general construction matters dealing with hospital design and operation.

CAA to level airport obstructions

(*Continued from page 37*)

formed previously unparalleled feats of maintaining flight schedules in murky weather through development of radar and other scientific aids to blind flying. Now the government, through CAA, is embarked on a program of equipping airports with ILS (Instrument Landing System) equipment which will make them accessible to aircraft despite low visibility.

Need greater glide-path

But ILS, which brings aircraft to the ground along a radio beam, requires far more low-level gliding space than an orthodox landing. CAA engineers say their instrument landing equipment is set to shoot its beam at air angle of 2½ degrees from the landing field. Any structure rising in the fan-shaped "glide path" on either side of the beam is a menace to aircraft riding it down through dark weather, CAA insists.

Airmen differ as to the proper width of the glide path at varying distances from the end of a runway. Some pilots claim any structure the height of a house within a mile of the approaches of a landing strip can be a hazard to instrument flying.

CAA's ideas on the subject are illustrated by its fight with the Braddock Light & Power Co., over an electric generating plant being built at Alexandria, Va. The plant is being built 8,200 feet from the end of the main runway at Washington's National Airport. CAA claims that the plant's stack, now planned to rise 193 feet above mean sea level, will present an "obstruction to air navigation" at the field. Height of the stacks should be reduced to a maximum of 162 feet, the agency insists.

For several days after the air-space condemnation law went on the books, CAA toyed with the idea of invoking it in the power plant case. There were hurried consultations with the justice department. Then CAA apparently gave up the idea, though the agency's attorneys felt sure they could condemn the Alexandria site.

The decision probably was made for the sake of good public relations. The city of Alexandria, which issued a building permit for the power plant, was set against lowering the stacks because of the possible effects on smoke control.

But CAA and air transport people say there are "dozens" of other airports whose instrument landing operations are handicapped by adjacent structures, either built or building.

Just what constitutes a "hazard to air navigation" in the judgment of airmen probably is best spelled out by a recently revised CAA regulation. In order to notify fliers of "hazards" along air routes CAA requires notification of new structures being erected near airports and civil airways. In this category, it put buildings "within 15,000 feet" of a landing area, any part of which is higher than five feet above ground level for each 500 feet distance from the field.

Cautious CAA probably would prefer to use the condemnation law as a club in persuading builders to keep tall structures away from airports. The air transport industry, however, is urging the agency to crack down fast on non-cooperating builders.

Random Lines *from an editor's notebook . . .*

. . . In which a British planning expert expresses the opinion that American planners should take a long-range view of city rebuilding problems

A trip around the United States has reinforced an opinion that large cities are in great danger of decay at an early date, according to comments written for "Public Construction" of the Federal Works Agency by F. J. Osborn, chairman of the executive committee, Town and Country Planning Association, London, England. His opinion was formed originally on the basis of experience and studies in his own country.

Without presuming to tell U. S. planners what could best be done in this country, Mr. Osborn expressed a definite feeling that Americans have not yet developed a solid body of agreed opinion as to what the future pattern of city and county arrangement should be. His conclusion was arrived at after talking to many of the people in this country who know most about our cities, including both planners, and practical real estate developers. The United States might miss the boat, as he expressed it, if a planning opportunity were to appear early or unexpectedly.

Great Britian, he said, thinks it business realism as well as decent humanism to set about rebuilding its cities in an intelligent way over whatever period may be required—thinking in immediate terms of 5 to 10 years and overall terms of 25, 50 or 100 years. Between 1942 and 1946, his country accepted a policy of: (1) limiting city growth, (2) dispersing some part of city industry and population, (3) reserving agricultural land that still survives for green belts around and between great cities, (4) building up smaller detached towns that are not already too large and perhaps need additional population, and (5) creating some new towns on fresh sites where they can be planned on a human scale.

There is no popular appeal in planning in the abstract, or in planning as a thing in itself, Mr. Osborn emphasized. In a democracy, he declared, the public will never give anybody powers simply to plan or control anything, and leave it to the planner to use those powers in any way he thinks best. It is necessary to have the appeal of some popular purpose, or group of popular purposes, that planning alone can bring about. If people are enthusiastic about an aim, they will support the necessary measures to attain it.

Until the United States has a solid base of agreed opinion among planners, Mr. Osborn failed to see how we can work out the minimum legislative powers, machinery and types of skill necessary to carry out purposeful planning. Once the basic purposes are accepted, citizens' organizations—national, regional and local—are needed as part of the setup of city and regional planning.

Not only must there be aims which go right home to the citizen and engage his support or elicit his passionate demands; but, at every stage of planning, the working out of the aims also needs citizen guidance, citizen instruction, citizen inspiration, Mr. Osborn declared. It is not a job, he said, that can ever be left wholly to elected people or experts.—V.B.S.

ROAD SHOW OPENS

The largest Road Show ever sponsored by the American Road Builders Association "played" to more than 20,000 visitors when it opened its doors at Soldiers Field, Chicago, July 16.

The show and accompanying functions and technical sessions, will remain open until July 24.

More than $8,000,000 worth of road-building equipment ranging from relatively tiny compressors and portable power units to huge carrying scrapers that have a capacity of 30 cu. yd. or more of material covered the 30-acre exhibit area.

Most colorful ceremony was the reception July 17 to representatives of 70 foreign guests.

Road promotion planned to lift foreign economies

Something new in foreign aid has just been announced by a group of American oil, automobile and rubber companies who have set up the International Road Federation to promote the development of highways abroad.

Formulated on the economic concept that systems of good roads are prerequisites to higher standards of living, the IRF has been organized to foster the establishment of good roads federations in those countries that do not have them and to encourage and support these and existing federations in other countries in planning and promoting sound programs of road improvements.

Commenting on the formation of the new IRF, Commissioner Thomas H. MacDonald of the U. S. Public Roads Administration said last week, "The enormous benefits that have resulted from an advanced development of highway transportation in the United States have deeply convinced the PRA of the fundamental importance of an adequate highway system as a means of advancing the internal economy and social opportunities of every nation.

"Effectuating a consistent, long-range program of highway improvement requires close cooperation between the public road officials and industry. Because the International Road Federation ideally is dedicated to the task of fostering such an attitude on the part of industry, we are happy to welcome it into the highway field. When the principles expressed by its founders are vigorously executed, we believe that highway improvement programs everywhere will benefit."

Origin and administration

Sponsors of the IRF are the Shell Union Oil Co., the Standard Oil Co. of New Jersey, the Socony-Vacuum Oil Co., five tire and rubber companies—Goodyear, Goodrich, United States, Firestone and General—and the Automobile Manufacturers Association. Guiding spirit in activating the idea was the Shell company, which has loaned one of its executives, J. H. Sembower, to act as executive director during the organizational period. He is being assisted in London by B. O. Masse, another Shell man, who will handle the work in Europe and the Middle East. Mr. Sembower, from Washington, will be concerned largely with the Central and South American countries.

This division of the new body into two administrative units is not only a result of geography, but also of differing requirements. In Europe, numerous road organizations were in existence even before the war, and five of the largest—from Great Britain, France, Sweden, Holland and Switzerland—are already affiliated with the IRF. For the countries south of the U. S. border, local, regional and national road organizations need to be created.

Once road promotion groups are set up in the various countries, they will be supplied with every sort of statistical, technical, economic and educational material that will assist them in encouraging and guiding the planning and execution by their respective governments of sound highway programs. In addition to the work of its own staff, IRF will rely on data developed by such existing U. S. organizations as the Automotive Safety Foundation, the American Road Builders Association, the U. S. Public Roads Administration, and others such as the Permanent International Association of Road Congresses, with which it has established liaison.

Program completed for Liege structural meeting

Copies of the program for the third congress of the International Association for Bridge and Structural Engineering, to be held in Liege, Belgium, Sept. 13-18, 1948, are now available from convention headquarters in that city at 139 quai de Rome. At the same time, the association announces from its headquarters in Zurich, Switzerland that the 8th volume of its "Publications" may now be ordered from Leemann & Co., Stockerstrasse 64, Zurich. First volume to be published since the war, it contains 15 papers totaling 310 pp. The papers are in the languages of origin—English, French and German—but summaries for each are given in all three languages. Papers presented at the Third Congress will be issued in a similar volume.

The Liege congress program will be divided into five sections in each of which a number of papers will be presented. The five general subjects are (1) assembling devices and structural details in steel structures; (2) developments in concrete and masonry buildings; (3) developments in long-span steel bridges; (4) slabs and curved structures in reinforced concrete; and (5) analysis of safety and effect of dynamic forces. The long span steel bridge session is under the chairmanship of O. H. Ammann, consulting engineer, New York, and a number of other U. S. engineers have declared their intention of attending the meetings of the congress.

Federal funds aid state hospital programs

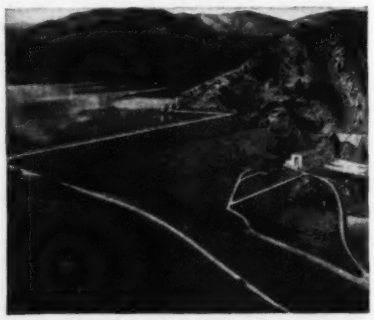
At the end of its first fiscal year in administering federal aid to the states for building local nonprofit hospitals and health facilities, the U. S. Public Health Service last week reported that it had approved applications for 352 projects in 43 states and territories. Total federal share is estimated to be $46,660,000.

Federal funds for the aid program are authorized by Public Law 725, the Hospital Survey and Reconstruction Act, passed in August, 1946. The law approved use of: (1) $3,000,000 to help the states survey their overall needs for hospitals and health centers, and (2) $75,000,000 a year for five years to assist the building of voluntary nonprofit state, county and city hospitals, health centers, laboratories and other health facilities.

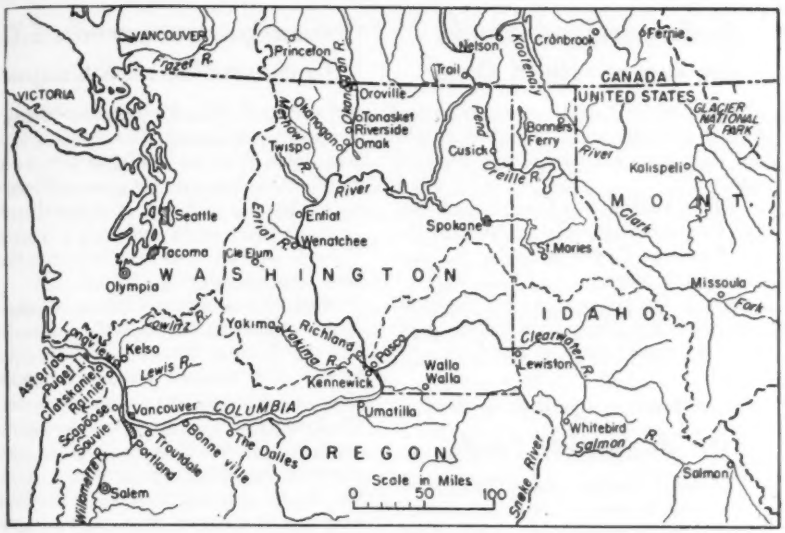
Each dollar of federal funds must be matched by two dollars of state or local funds.

Six weeks before the end of the fiscal year, the Public Health Service reported that it had approved the state-wide programs of 46 states and territories. The nation's total civilian needs for additional hospital beds was estimated at 904,000. The state programs listed 465 existing health centers of satisfactory quality and called for 1,865 additional to meet the needs.

Based on these state surveys the federal-aid program should take care of about 13 percent of all the needs disclosed. Health centers to total more than $1,000,000,000 will be financed under the five-year program.



FOR NEW LANDS — Palisade Dam, planned by the Corps of Engineers (*ENR* July 8, p. 103) will make available supplemental water for 650,000 acres in the Snake River Valley in Idaho, produce hydro power and provide flood control benefits. The structure will be an earthfill dam, 260 ft. above ground level and 2,190 ft. long, creating a 1,400,000 ac. ft. reservoir.



Report on northwest floods credits levees, Army for minimizing damage

By Col. Theron D. Weaver
North Pacific Division Engineer, Corps of Engineers
Special to Engineering News-Record

During May and June of this year, more than 150,000 acres of diked lands, including both agricultural and industrialized areas, in the flood plain from northern Idaho and western Montana to the lower Columbia Valley, were saved from inundation by levees, and by the fight waged under the technical supervision of the Corps of Engineers. The record flood occurred in June, 1894.

Flood Damage Listed

Extensive flood damage was suffered in such widely separated localities as the Clark Fork River above Missoula, Mont., the Bonners Ferry region on the Kootenay River in northern Idaho, and Puget Island between Oregon and Washington near the mouth of the Columbia. Lowlands in the Methow River and the Okanogan River valleys in north central Washington and in the Clearwater River Valley in Idaho—where there were no dikes—were also hard hit.

The Kootenay River area near Bonners Ferry was one of the first to feel the impact of the flood which struck May 20. About 38,000 acres in 15 private diking districts were inundated by overtopping of the dikes in the area when the water exceeded the 1894 flood mark by one foot.

The Okanogan, Methow and Entiat river valleys were also without dikes, and in these areas some 28,000 acres of farm lands were inundated. But emergency barriers thrown up by engineers prevented heavy losses in urban areas.

In the Cle Elum, Wash., area, 80 acres in the urban district were saved by protecting levees that were heightened and extended 2,300 ft. by engineers and voluntary workers.

Towns Mobilize for Water Fight

Richland, Wash., which mushroomed during the war, was fortunate in having available much heavy construction equipment. This equipment, together with operators and laborers, was quickly mobilized against the rising flood. Prompt action here saved many millions of dollars in the city and adjacent areas.

Although considerable damage was caused in the St. Maries, Idaho, area, the loss was greatly reduced by effective action of Army Engineers and troops from Fort Lewis, in cooperation with local residents. A total of 4,850 acres was within leveed districts, but some of the dikes were overtopped by the flood. Much of the loss was attributed to lack of proper maintenance by the local district. The damage incurred was estimated as 70 percent less than would have resulted without prompt action under the Army Engineers' technical supervision.

As flood waters continued to recede early in July, Corps of Engineers field surveys were under way as a preliminary step to rehabilitating damaged levees. Analysis of field reports indicates that hundreds of millions of dollars in property values were saved, despite heavy losses in some localities. Many of the levees had been raised and improved by the Army Engineers from 1938 to 1942.

Because of the relatively high development of some of the property involved, the lower Columbia area suffered extensive damage from the flood. But the 2½ million dollars spent by the Corps of Engineers in the flood fight in this area saved all but eleven of the 44 diking districts, with their total of 290 miles of levees, including one small private drainage district.

Within this area, extending from the mouth of the Sandy River to the Columbia's mouth, 64,985 acres out of a total of 89,500 acres were undamaged by flood waters.

The flood deposited about 120,000 cu. yd. of sand, silt and some rocks in the Dalles-Celilo Canal, in the Columbia River two miles above The Dalles, and washed out about 600 yards of riprap. The canal was closed to traffic while clearing operations and repairs were under way.

Receding flood waters revealed a 765-ft. V-shaped cut with a maximum depth of 10 ft. in the upstream leg of the cofferdam on the Washington side of the Columbia River at the McNary Dam site. This was the only major damage suffered at McNary.

Only about 20,000 acres of the 100,000 total acreage in the Yakima, Wash., area suffered flood damage. The city suffered only light damage owing to a recently completed system of levees that the Corps of Engineers had built to tie in with dikes previously constructed by WPA labor.

Storage reservoirs needed

The flood focuses attention on the need for storage reservoirs, supplementing levees, for adequate protection during major floods.

It is estimated that multiple-purpose reservoirs providing the equivalent of 14,000,000 acre-feet of 100 percent effective flood control storage, properly distributed on major tributaries and on the Columbia's main stem, would be required to reduce the 1894 record flood to 800,000 cfs. or less in the lower river.

Protection of the lower Columbia River, under conditions of controlled flow, would still require the use of levees, reinforced and extended where necessary. Protection against the largest floods by means of levees alone is impracticable in this basin on account of the highly pervious nature of materials in the valley floor.

A comprehensive water resources plan providing flood protection is contemplated by the Corps of Engineers' Columbia River and Tributaries Review Report now being completed in the North Pacific Division, to be submitted to the Chief of Engineers this fall.

Packers urge levees to control Columbia

A system of strongly constructed high levees to control Columbia River floods has been recommended by the Columbia River Packers' Association of Astoria, Ore.

Concerning construction of "so-called multiple-purpose dams," a statement by the group said that the dams built with power production as the principal benefit factor are of "no appreciable value" in flood control. "The only flood protection that can be expected from dams on the Columbia is from structures particularly built for this purpose. They would be tremendously expensive and may be of use only once in a century," the association said.

Survey shows increase in water-power plants

Total capacity of water-power plants of the world at the end of 1947 was 86,900,000-hp., as determined by the Geological Survey, U. S. Department of the Interior.

Installed capacity of water wheels increased steadily from 23,000,000-hp. in 1920 to the present figure. The increase appears to be continuing, taking the world as a whole. Shortages of fuels (oil, gas and coal) and their increase in price make water power appear more desirable than ever.

There is indication of a possible increase of about 1,000,000-hp. a year in the U. S. in the next few years.

U. S. purchases land for Buggs Island Dam

The Federal Government has agreed to pay $800,000 for 17,000 acres of land for the Buggs Island Dam reservoir area.

An agreement has been signed with the Roanoke Power Co., a subsidiary of the Carolina Power & Light, for purchase of the land.

The 17,000 acres represent about 20 percent of the land which will be inundated by construction of the dam.

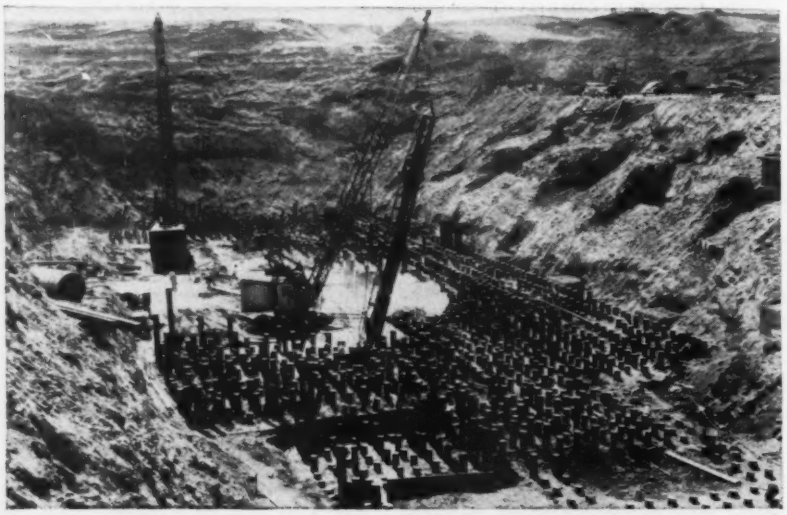
Sanitation group asks city to furnish funds

The Interstate Sanitation Commission has urged action be taken as soon as possible to end pollution of New York harbor.

Asking pledged expenditures of $20,000,000 a year for the next ten years, the commission wants the city's declaration that funds will be made available.

The program for building six new sewage disposal plants in the next six years, at a cost of $79,000,000, seems blocked by financing problems. A city representative, who promised full cooperation with the commission, was unable to explain how the projects would be financed.

J. Spencer Smith, chairman, explained that it is the "commission's responsibility to order the pollution eliminated" and asked to have "the city ready to set aside substantial sums to abate the pollution in a reasonable period."



PUMP PLANT SITE—Foundation piling has been completed and concrete pouring is now under way for the Tracy pumping plant, key structure of the Central Valley Project. Three thousand timber piles were sunk to support the floor of the structure, through which water will pass at 4,600 cfs. as it is pumped into the Delta-Mendota canal after a lift of 200 ft.

Arrangement permits S.C. to extend Santee-Cooper

The South Carolina Public Service Authority announced last week that it was launching an $800,000 construction and replacement program. Present plans call for addition of a small generating station at the authority's Santee-Cooper project and for transmission line construction.

Most interesting facet of the program is an agreement between the authority and the Federal Works Agency, holder of the bonds through which the Santee-Cooper development was financed. FWA on June 25 approved postponement for five years of a $331,000 payment to the federal government to retire bonds due on July 1. This sum was placed instead in a new capital improvement fund established by the authority to finance the construction and replacement program. FWA also approved the transfer of some $189,000 to the capital improvement fund from monies set aside for depreciation by the authority in a special contingency fund.

Announce plans for new natural gas pipelines

Construction of 210 miles of natural gas pipe line in Texas and Louisiana will be done by the H. C. Price Construction Co., of Bartlesville, Okla., and the Bechtel Corp., of California, according to a recent announcement by the Tennessee Gas Transmission Co. of Houston.

This particular section will lie between El Campo, Tex., and Natchitoches, La. Construction will start about August 1.

Pipe in 30 and 31-in. sizes was obtained in a trade from the Trans-Arabian Pipe Line Co. when that company's export permits to middle east oil fields were held up by the Department of Commerce.

Authorization is sought for construction of a 451-mile natural gas pipe line, at an estimated cost of $28,000,000, by the San Juan Pipeline Co., El Paso, Tex. The proposed 26-in. line would extend from northwestern New Mexico to Mojave County, Ariz.

A 650-mile line of 20-in. pipe linking Corsicana, Tex., and Patoka, Ill., was dedicated recently.

Portland, Me. will be joined with Bangor by a 124-mile pipeline to transport finished oil products for the Socony-Vacuum Oil Co. The 6-in. line will have storage terminals at Auburn, Lewiston, Hallowell and Bangor.

OBITUARY

Frank P. Robbins, 62, associated with Montana highway department for 17 years and more recently with the state highway department of Minnesota, passed away recently.

Charles West Cullen, 83, former chairman of the Delaware State Highway Department, died July 10, at Lewis, Del.

William Bernard Bates, 69, former city manager of Portsmouth, Va., and one-time city engineer at Roanoke, Va., died July 10. A graduate of Virginia Polytechnic Institute, he was for 13 years prior to his retirement in 1945 a resident engineer with the Virginia State Highway Department.

Ralf Woolley, senior hydraulic engineer for the United States Geological Survey, died in Salt Lake City, Utah, July 1. Mr. Woolley received a degree in mining engineering from the University of Utah in 1909 and a degree in civil engineering in 1920. He had held his post with the Geological Survey for a period of almost 30 years. At the time of his death he was a member of the Advisory Board on civil engineering for the University of Utah and a member of the board of engineering examiners for the State of Utah.

Edgar S. Miles, 66, chief engineer and president of Angus Robertson Ltd., Montreal, Canada, engineering firm, died at his home in Toronto recently. A 1904 graduate of the University of New Brunswick, Mr. Miles was connected with the construction of many well known Canadian engineering works, including the Welland Ship Canal, approaches to the Jacques Cartier Bridge in Montreal and the Alexander Pier.

Housing is requirement of Army and Air Forces

Military public works construction by the Corps of Engineers in fiscal 1949 will concentrate largely on houses for married officers and enlisted men and bachelor quarters for unmarried personnel. Army Secretary Royall and Air Force Secretary Symington stressed the importance of the housing program last week.

The program calls for 3,500 family units, estimated to cost $54,000,000, and bachelor quarters for 7,400 men, costing $21,000,000.

Military demands for steel to be light in '49

This year's military procurement program—for the twelve months of fiscal '49—should have no disabling effect on construction or any other branch of the business economy. The impact on important basic materials, such as steel, for example, will be slight.

Military authorities compute their total estimated demand for steel during the year at 1,250,000 tons of carbon and alloy metal. This is about 2.1 percent of the annual U. S. production of steel. The Navy will take the greater part of the military steel. Heaviest demand will be in steel plate, followed by sheet and strip steel.

Turnpike access planned out of Philadelphia

Plans for a project to link the eastern terminal of the extended Pennsylvania Turnpike to downtown Philadelphia were announced by Gov. James H. Duff recently. The improvement, he indicated, will be a multi-million dollar project similar to that being made in Pittsburgh, where the Penn-Lincoln Parkway will link with the western extension of the toll road.

The governor indicated the 1949 legislature would be asked to boost the state's gasoline tax to help pay the cost of highway construction.

Other major highway improvements announced include a new bridge across the Susquehanna River between Harrisburg and Lemoyne. In the six-month period ending July 1, Pennsylvania spent $81,000,000 on road building, according to the governor.

Army OK received for Virginia highway span

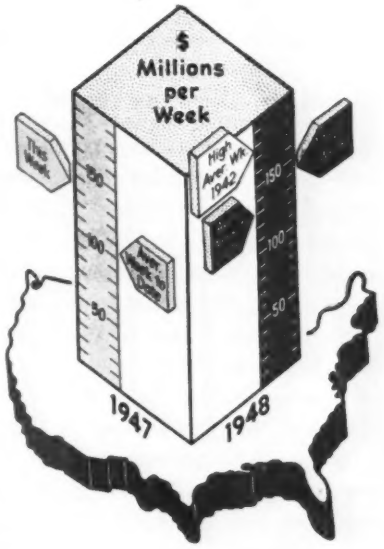
Authorization has been received from the Corps of Engineers for construction of a bridge over the Rappahannock River at Grey's Point, in Virginia, highway commissioner James A. Anderson announced recently.

Preliminary plans for the Grey's Point bridge call for a span 10,630-ft. long. More than a mile of the bridge will stretch over water 60-ft. deep.

Construction of the span is authorized under the revenue bond act of 1940. It will be included in a single bond issue of some $20,000,000.

Work is progressing steadily on the low-level, double swing-span Yorktown Bridge (*ENR* July 1, p. 9), according to the commissioner.

CONSTRUCTION ACTIVITY



As Reported this week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of July 22 1948	Cumulative 1948 (30 wks.)	Cumulative 1947 (30 wks.)
Federal	$10,152	$588,376	$399,897
State & Mun.	63,277	1,414,797	967,832
Total Public.	$73,429	$2,003,173	$1,367,729
Total Private	69,784	1,929,639	1,729,540
U. S. Total..	**$143,213**	**$3,932,812**	**$3,097,269**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1948 (30 wks.)	Cumulative 1947 (30 wks.)
Waterworks ...	$4,896	$108,702	$65,074
Sewerage	3,719	123,259	55,048
Bridges	3,524	167,886	93,622
Highways	20,196	576,815	464,612
Earthwork, Waterways	2,689	297,457	189,128
Buildings, Public	33,621	607,692	312,994
Industrial ...	8,812	569,456	436,419
Commercial .	46,334	1,114,214	1,031,323
Unclassified ...	19,422	369,351	429,049

NOTE: Minimum size projects included are: Waterworks and waterway projects, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (30 wks.)	Cumulative 1947 (30 wks.)
NON-FEDERAL	$3,041,733	$1,396,593
Corporate Securities	1,538,279	465,383
State and Municipal	1,076,165	683,499
Fed. Aid Highway.	427,289	247,711
FEDERAL	$1,558,932	818,729
Total Capital	**$4,600,665**	**$2,215,322**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	July '48	463.23	222.67
Building Cost	July '48	342.42	185.10
Volume	June '48	282	124

EDITORIALS

VOLUME 141 NUMBER 4

July 22, 1948

Greatest Show on Earth

NEVER IN HISTORY, nor nowhere else in the world, could such an exhibit of construction machines be staged as is being viewed by an estimated 100,000 visitors this week in Chicago. The 1948 Road Show is truly the greatest show on earth. And yet it is none too big, for, never before was there such a need for mechanical aids to the American roadbuilder whose requirements have grown to all but impossible magnitudes. Indeed, without appreciation of this fact, the Road Show is more like a fantastic pageant of Gargantua than the hard-headed business proposition that it really is. For example machine units reach 50 ft. in length, and rise 110 ft. into the air. The visitor sees the world's largest in dragline buckets (30 cu. yd.); in bulldozers (750 hp.); in tractors (36,000 lb. tractive effort); in earth-moving wagons (25 cu. yd.); in elevating graders (300-1000 cu. yd. per hr.); in rubber tires (10 ft. dia.). All this elicits comment, but significantly is not awesome to contractors who are willing to pay $60,000 for a bulldozer and $90,000 for a power shovel. In fact, so inured to size are the visitors that a gag exhibit consisting of a wooden model of the world's largest tractor, three times normal size, is often taken for the real thing. This spirit of accepting bigness, and high speed and new design—above all of accepting mechanization—is America's great hope in roadbuilding. Only by putting the Road Show to work, on the roads, can we meet the challenge that wartime neglect of construction and the growing motorized columns of cars and trucks have brought to the nation's doorstep.

Highways for the World

WITH ALL EYES FOCUSED ON ROADS, announcement of the formation of an organization known as the International Road Federation could not have come at a better time. Conceived and financed by a group of American oil, automobile and tire companies, the plans for the I.R.F. represent business statesmanship at its best. Taking the long view, amply supported by history, that raised standards of living follow highway development, the companies have dedicated their efforts to the promotion, in all countries of the world, of sound road planning. When the raised standards of living occur, these companies will, of course, get their share of the business, but so also will the proprietors of farms and factories in general. In the meantime, by creating popular desire for the benefits derived from roads, by educating public officials in the economics of road development, and then channeling to them the technical information available in all parts of the world, the I.R.F. will be performing a service that is not now existent. Precedent for such service on the domestic front exists in such organizations as the Automotive Safety Foundation and the Highway Users Conference. In planning to extend it to worldwide dimensions, the new International Road Federation is blazing a trail along which both peace and prosperity can grow in scope and permanence.

New Facts On Chlorination

ALTHOUGH CHLORINE has been used in water treatment for half a century, the theory of its action as a disinfectant has never been perfectly understood. This is the reason why so much importance must be attached to an interim report of studies at the Harvard Graduate School of Engineering where Dean Gordon M. Fair and his colleagues have been conducting fundamental research on the mechanism of chlorine disinfection. Admitting that much more work remains to be done, the Harvard investigators nevertheless are now able to point to basically new concepts, as outlined on p. 60 of this issue. These include explanations of how chlorine dissolved in water exerts a killing action on bacteria, and how chlorine solutions are modified in their action by the presence of ammonia and other organic amines frequently found in natural waters. Application of these basic findings, and those that logically should follow as research continues, promises new efficiency and economy in the art of water treatment.

Cheap Irrigation Laterals

THE BUREAU OF RECLAMATION is headed in the right direction in searching for inexpensive materials to line small irrigation canals and in encouraging contractors to develop efficient machine methods for such work, as is reported elsewhere in this issue. In these days of high costs, everything possible must be done to keep the cost of water for irrigation within reasonable limits. It has been

stated that the Pasco lateral system cost some $130 for each acre served, not including the pumping plant nor the proportionate share of the Columbia Basin project as a whole. With the savings developed by improved methods, this can well be reduced to, say, $100 an acre, but this is still higher than the land in the Pasco area can bear. Even more, therefore, must be done to reduce costs on lateral systems. Possibilities lie in standardization on canal sizes, simplifying measuring and control structures, and also in developing cheaper linings. Only when costs are within reasonable limits can reclamation projects succeed.

Confusion in Pricing

ANTI-MONOPOLY ADVOCATES have claimed a great victory in the Supreme Court's decision against the basing-point pricing system for cement, which last week extended its effect to steel. But it is not so certain that they have not, in the process, trampled the public, whom they vowed to protect. In outlawing what was charged to be a monopolistic device—multiple-basing-point pricing in cement—they may have succeeded in legalizing a monopoly—a cement plant in a trade area unreachable economically by any other cement plant. And in seeking to assure the purchaser of freely-competitive and, therefore, lower prices, they have only succeeded in raising his costs.

The immediate problem posed by the abandonment of delivered prices relates to the f.o.b. mill prices that cement and steel manufacturers will charge. These prices, as of this week, are higher at most mills, suggesting that prior prices were bolstered by phantom freight income and, therefore, did not reflect true production costs. About all the purchaser can do is to trust in the business statesmanship of the manufacturer to set a fair f.o.b. mill price and then to hire an expert to figure freight costs from the various mills that have production to sell.

As to the future, the implications of the new pricing system are particularly arresting with respect to changes in plant locations. New cement plants may have to be built in areas not now served adequately or economically. Steel production facilities are not so easily duplicated, so that plants using steel in manufacturing processes may have to move closer to steel-making centers to meet the costs of competitors more favorably located. In all of this, some of our fine ideas of industrial decentralization may have to be revised.

In this period of great prosperity, it is the user who is at a disadvantage. Probably in slack times, when production capacity exceeds demand, it will be the manufacturer who will have problems. But when anyone goes broke, whether producer or consumer, it is not a good thing. Probably until all the evidence is in, and that may be some years hence, the profit or loss that will accrue to the American economy from the Supreme Court basing point price decision cannot be tallied up. On balance at the moment, confusion and higher costs are the only tangible results.

Just Another Dam

WHEN THE CONTRACT for construction of Hungry Horse Dam was signed several weeks ago, that event went almost unnoticed, yet it was the second largest contract to be signed in the 46-year history of the Bureau of Reclamation—$43,431,000, as compared to $48,890,995 for Hoover Dam. Signing of the Hoover Dam contract in 1931, it will be recalled, was heralded as a major event.

The reason for this change is not hard to find, yet it seems to warrant some comment. As we look back now we can see that the Hoover Dam contract marked the beginning of a new era in construction by contract. The job was so much larger than any previously handled by one contractor as to result in the organization of a new firm by six large contracting companies—called Six Companies, Inc. That set a precedent and developed a pattern that proved to be of great service when the war came along with still greater construction jobs to be prosecuted. So when today three large construction companies combine their resources and skill to take on the job of building Hungry Horse Dam in Montana, it is "just another dam." What was a novelty in 1931 is now commonplace.

Joint-venture bidding unquestionably extends the range of capacity that the construction industry can offer. Reserved for those jobs too big for an individual contractor to handle, it constitutes a valuable addition to the methods of conducting our construction business.

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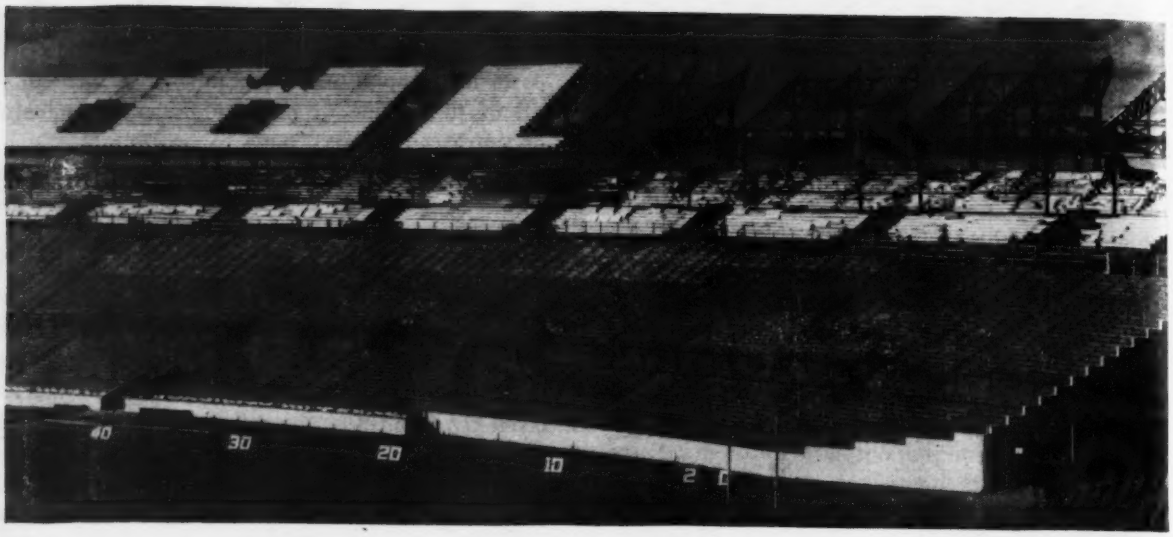
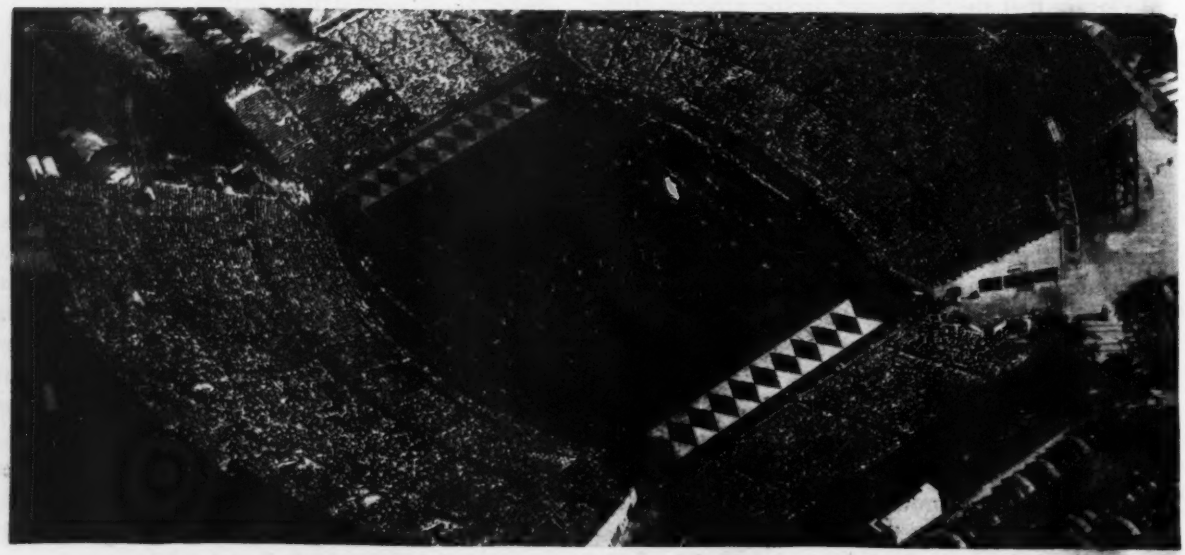


Double Decks of Precast Concrete on Steel Frame



Enlarge Orange Bowl Stadium

THE SEATING CAPACITY of the Orange Bowl Stadium at Miami, Fla., has been increased from 37,000 to 60,000 by methods that permitted rapid and economical construction. Despite two hurricanes and a major flood, only 75 working days were required from the setting of the first column baseplate to the completion of the 23,000 new seats.

Used primarily for football the Orange Bowl before enlargement was an oval-shaped, single-deck stadium having a structural steel framework and a steel deck, with temporary bleachers at the ends of the oval. Maintenance of the existing stadium —especially the steel deck—has been costly. Maintenance costs for the additions are expected to be low.

In the enlargement work, seats were added at the two sides back of the existing permanent seats. It was decided to use a double-deck design to provide the desired capacity without making the distance from the back seats to the playing field too great (Fig. 1).

A design entirely of steel was considered, as was one of reinforced concrete. Final choice called for a steel framework, with a deck of precast concrete members and seats of cypress plank. With this layout, cost of construction to provide 23,000 additional seats was about $1,400,000—

$30,000 less than the estimated cost of the steel-deck design and only about one-half the estimated cost for building the two additions of cast-in-place concrete. The precast concrete deck is expected to be much less noisy than a steel deck.

Each of the new sections has a maximum height of nearly 100 ft. above the field and accommodates 20 rows of seats on the lower deck and 26 rows on the upper deck. In view of this height, adequate safeguard against wind stresses was especially important. Hence, the new construction was designed for a maximum wind velocity of 150 mph. Most of the bending moment from wind on the upper deck is taken by the rear columns.

Like the existing stadium, the additions are built on a curve. To simplify fabrication and erection, the framework was designed in three-bay sections, with the distance between the front and rear columns in the first two bays constant, and a variable spacing in the third bay. This arrangement greatly simplified fabrication of both steel and concrete units and permitted considerable duplication of members. Spacing of columns of a bent averages about 14 ft., and the distance between bents is about 17 ft. Columns as heavy as 10-in. WF 100-lb. members were required.

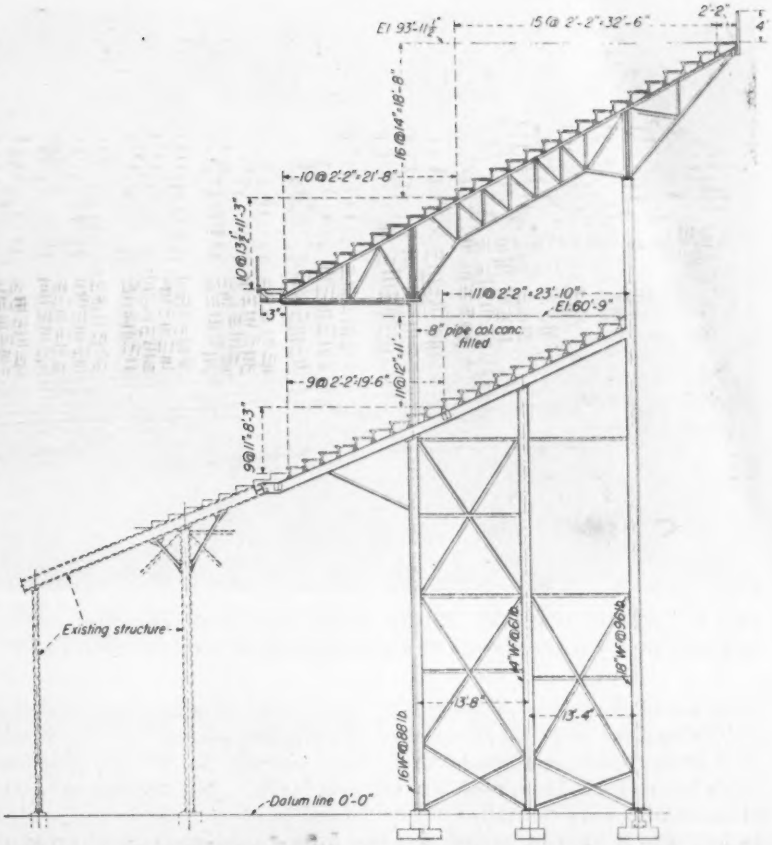


FIG. 1. A DOUBLE-DECK ADDITION at each side increased the size of the Orange Bowl stadium from 37,000 to 60,000 seats.

Bents assembled on the ground

Erection of the steel framework was greatly simplified and speeded by assembly on the ground of the three columns and bracing for a bent. A crawler crane equipped with a 100-ft. boom raised the assembly as a unit. The heaviest bent raised in this manner had a total weight of 13 tons. A second crane followed closely behind to erect the struts and the remaining bracing—the two rigs being able to erect eight full bents in an 8-hour day. Framework for the upper deck was assembled in three-truss units and raised by two cranes (Fig. 2).

FIG. 2. STEEL ERECTION was expedited by assembling the framework for the upper deck in three-truss units, which were raised by two crawler cranes.

Most shop and field connections were of riveted design, but some welding was employed. Structural steel requirements totalled 2,500 tons. All the steel was given a shop coat of red lead, a field coat of the same paint, and two field coats of an aluminum paint containing graphite.

The precast deck, which is designed for a live load of 100 psf. plus 50 percent impact, is of the special design shown by Fig. 4. All joists are 14 in. deep and have 4¾-in. flanges and a 2-in. web, varying in length from 4 ft. to 20 ft. 6 in. The reinforcing ranges from a single ⅜-in. round bar, top and bottom, for the short members; to a 1-in. square bar, top and bottom, for the longest joists. Stirrups are used for all joists longer than 4 ft.

All treads were made 2 ft. 2 in. wide. By varying the thickness of the edges it was possible to vary the rise from 11" in. to 1 ft. 2 in., the

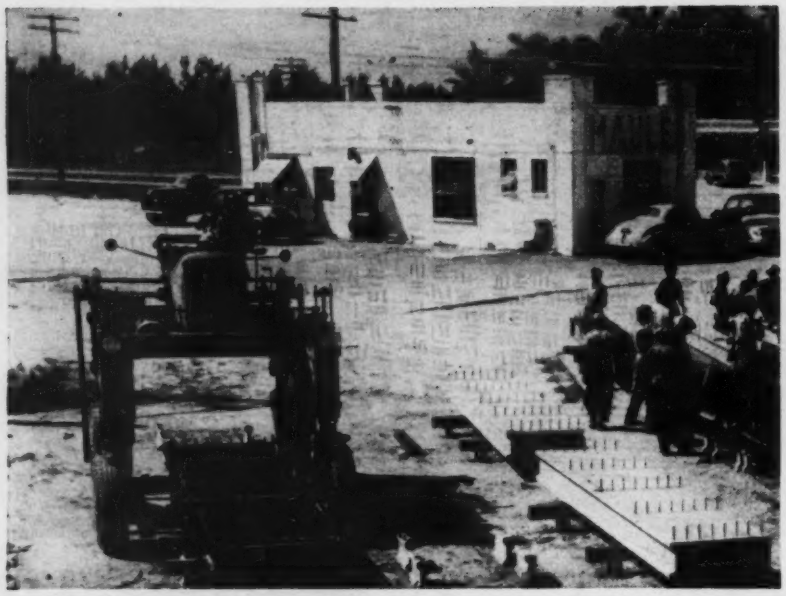


FIG. 3. FOR PRECASTING JOISTS special steel forms assembled outside in 8-joist units were transferred by a straddle truck to a central casting point.

thickness of the center of the tread slab being fixed at 1½ in. The slabs used for the treads, reinforced with a single layer of 4 x 12-in. mesh made of No. 9 wire, were generally limited in length to 3 ft. 6 in. to permit a section to be handled easily by two men.

Joists and slabs were precast at an existing plant several miles from the project. The reinforcing assemblies for the joists were fabricated by welding on an assembly-line basis under roof. In this work, the reinforcing bars were welded to the ⅝-in. dia. bolts used to tie slabs to the joists.

Multiple forms speed production

Special steel forms were assembled outside in units that permitted eight joists to be cast at one time (Fig. 3). After assembly, a form unit was transported by a straddle truck to a special casting platform, also under roof, where the concrete could be chuted into place.

Individual steel forms were used in manufacturing the slabs. These forms were assembled under roof on a large floor and the concrete delivered from the mixer by rubber-tired buggies.

A concrete having a minimum strength of 3,500 psi. at 28 days was specified for the joists and a 3,000-psi. concrete for the slabs. Normally, a high-early strength cement was used. The coarse aggregate consisted of pea gravel of about ½-in. dia. maximum size and the fine aggregate was river sand. All concrete was vibrated in place in the forms.

After a minimum curing period of seven days, the joists were transported to the job by the straddle truck. The slabs were transported by a regular truck.

A crane was used to erect the concrete joists, placing them on brackets shop-welded to the structural framing. A crane also placed a number of the slabs on a completed portion of the deck, from where they were distributed by hand. A mastic was used at the rear of the slab to seal the joint between the slab and the joists to prevent water from running from the deck onto the structural framework.

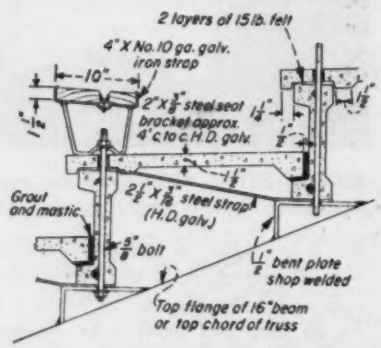

2 layers of 15 lb. felt
4" X No. 10 ga. galv. iron strap
10"
2" X ⅜" steel seat bracket approx. 4' C to C. H. D. galv.
1½"
1½"
Grout and mastic
2½" X ⅜" steel strap (H. D. galv.)
⅝" bolt
½" bent plate shop welded
Top flange of 16" beam or top chord of truss

FIG. 4. THE DECK of the additions is made of precast concrete risers and treads bolted together. Seats are cypress plank.

Cypress planks, 2 x 4-in., fastened in place by a bolted spreader on a 2 x $\frac{3}{16}$ in. steel-strap seat bracket, form the seats (Fig. 4). The brackets are secured to the deck by utilizing the bolts that tie the slabs to the joists.

Provisions for circulation

Eight ramps were made sufficiently large to permit a crowd of 60,000 people to enter or leave the completed structure in less than 20 min. The ramps were designed for a 150-psi. load plus 50 percent impact. A steel-channel type flooring surfaced with 1 in. of concrete was used in their construction.

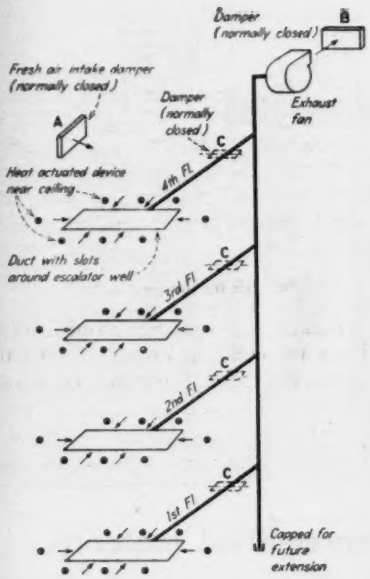
Reinforced concrete walks 10-ft. wide are continuous around both sides of the stadium at two elevations, providing access to concession booths and rest rooms. The lower walk is 36 ft. above the ground and the higher is 69 ft.

The increase in size of the stadium necessitated relocation of light towers. The lighting system was improved by 10 percent over-voltage operation and the installation of more modern floodlights—sufficient lights were installed to provide a computed average illumination of about 35 ft.-candles on the playing field.

A sound-insulated press box is located in the trusses under the upper deck between the two 20-yd. line markers to obtain a clear and unobstructed view of the playing field. Also, at the top of the upper deck is located a sheltered photographers' platform 150 ft. long, centered on the 50-yd line.

All engineering design work, layouts and details for enlargement of the stadium were handled by the design division of the Department of Engineering, City of Miami, Raymond A. Williams, director. Arthur E. Darlow, engineer of design, supervised the planning, assisted by M. M. Vaviloff, city architect. William Lee was resident engineer for the city.

Gust K. Newberg Construction Co. of Chicago and Miami was the general contractor. Calvert Iron Works, Atlanta, Ga., fabricated and erected the structural steel and the precast concrete work was done by Maule Industries, Inc., of Miami.



ESCALATORS in the Terrace Plaza Hotel Building are equipped with a sprinkler and air-exhaust system to prevent the spread of fire. Thermostats on columns will activate fan to draw air into an exhaust duct through slots near ceiling.

Air System Shields Escalators from Fire

PASSAGE of fire and smoke through floor openings of an uninclosed escalator well in the Terrace Plaza Hotel Building is prevented by air-exhaust and sprinkler systems. The former will halt the updraft of fumes and the latter will eliminate convection currents by spraying water to cool the heated air.

A pair of escalators extend from the first to the fifth floor in the J. C. Penney department-store portion of this unusual edifice, recently built in Cincinnati, Ohio, by Thomas Emery's Sons, Inc. (*ENR* Aug. 7, 1947, vol. p. 196). The store occupies seven floors and a basement at one end of the structure. Windowless above the main floor, it is completely air conditioned, supply and recirculating fans maintaining the quantities of fresh air needed.

At each floor, the escalator well is encircled by a high-velocity duct that projects no further below the ceiling than the escalator motor pit. Provided with slots for air intake, this duct is connected to a vertical riser that leads to an exhaust fan on the seventh floor. A fresh-air intake for the fire-protection system is located on the fifth floor. Dampers that are normally kept closed are located at each floor in the duct leading to the riser, at the discharge of the exhaust fan and at the fresh-air intake, so that there is no interference with the air-conditioning system.

Located to cover the entire floor area, rate-of-rise thermostats have been placed on various columns near the ceiling.

If subjected to a rapid change of temperature, a thermostat will activate the automatic air-control system. The following will then take place:

Operation of the escalators delivering passengers to the floor on which the fire is located ceases. The air-conditioning system supply fan for that floor stops. Fire damper C (see sketch) in the exhaust duct on that floor opens. The seventh-floor exhaust fan starts and its discharge damper B opens. And the fresh-air intake damper A opens.

Air is drawn from the fifth floor down the escalator well to the floor involved, and is there drawn into the slotted duct. The vast downward flow of air is sufficient to overcome the normal updraft of fire gases and prevent the spread of smoke and heat to the upper floors. This system can also be set in operation manually, by throwing a switch provided at each floor level.

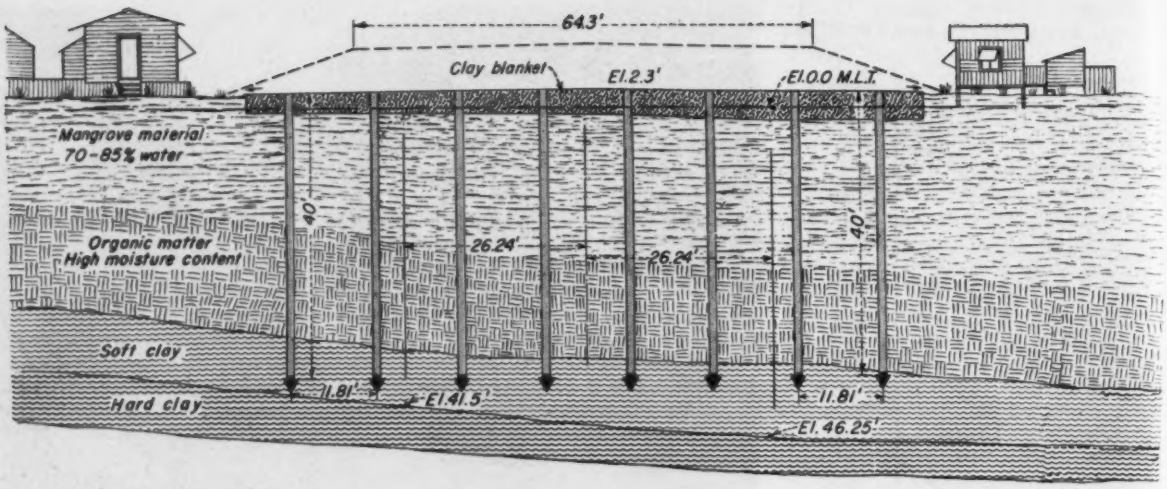
In addition to the air-exhaust system, protection is also provided by a deluge sprinkler system with rate-of-rise pilot heads located around the well. Should the air become so hot as to activate these heads, a water curtain is formed around the escalators.

A fire-detection service is provided by the American District Telegraph system. When the fire-protection system operates, the central office is notified simultaneously and fire apparatus are immediately dispatched.

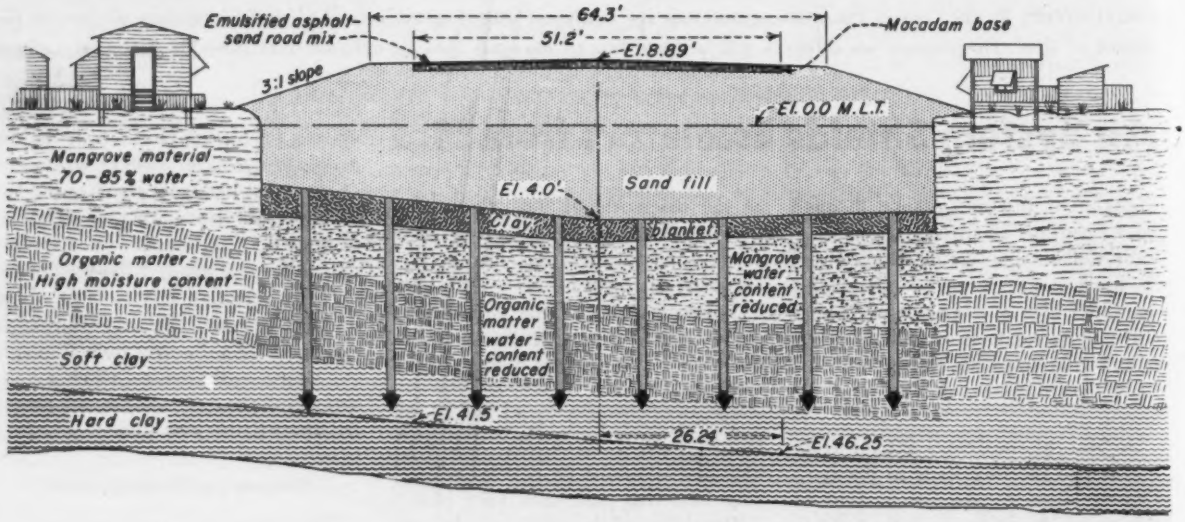
Systems made independent

The automatic pneumatic-control system is completely separate from that which operates the air-conditioning controls. All electric supply lines to the control air compressor and the fan are taken off the electric service ahead of the main switch and are run in duplicate. The loss of pressure in the pneumatic-control air piping, the stopping of any air-conditioning fan, and the operation of the fire-protection system are all individually signaled to the engineer's office.

The protective system was designed by Jaros, Baum & Bolles, consulting engineers, applying principles verified by tests conducted by Westinghouse Electric Corp., Otis Elevator Co. and Grinnell Co. (*ENR* May 22, 1947, vol. p. 849). Skidmore, Owings & Merrill, architects, assisted in the design.



Sand Drains inserted into unstable, water-filled material



Stabilize Muck in Puerto Rico

J. C. Carpenter

District Engineer, Public Roads Administration
Washington, D. C.

PUERTO RICO's most important highway—between San Juan and Point Borinquen on the island's northern coast—has been extended by effective use of vertical sand drains to stabilize a muck-peat foundation material. A considerable cost saving resulted from use of the drains for this 0.34-mi. project, which called for a four-lane highway across a marsh bordering the northeast approach to the Martin Pena Channel where the highway leaves San Juan.

Before adoption of the sand-drain method, cost estimates were prepared for several other designs. These included: A concrete trestle, steel sheetpiling on both sides with pumped-in fill, timber sheetpiling on a similar design, hydraulic fill placed after excavating a trench to hard clay, a plank floor on closely-spaced joists supported by timber piles, a jetted sand fill down to the clay after removal of the surface mat, a timber trestle, and a blasted trench refilled with pumped or truck-delivered fill.

The sand-drain method was found to be the least expensive, the other methods ranging from 1.8 to 6.0 times as costly. Also, most of the other methods would have required material difficult to obtain during wartime.

California method followed

With two major changes, the procedure adopted followed methods developed by the California State Highway Department (*ENR* March 6, 1947, vol. p. 386). The marsh was so

soft and water-logged that equipment could not be operated on it without support, so a blanket of carefully selected tough clay was spread over the entire area.

California practice indicated the use of a 2-ft. thick horizontal layer of sand at the top of the drains to carry the water to the sides of the fill. Anticipating a settlement of from 10 to 20 ft., it was believed that this lateral movement of the water would not take place if an impervious material were used to make the fill, and the design was changed to provide for the use of sand for the entire fill above the clay blanket (Fig. 3). Beach sand was available within reasonable haul. The clay blanket under the sand fill acted as a tough membrane that prevented the intrusion of the muck into the fill and avoided any faulting of the embankment. It also produced uniform settlement of the fill.

The original design called for 30-in. dia. drains on 12-ft. centers each way. Equipment to build this size was not available, but it was possible to obtain 12-in. steel pipe that could be driven as a mandrel. Therefore, it was decided to use the 12-in. drains spaced 11.8 ft. transversely and 9.8 ft. longitudinally. Observations during construction indicated that more rapid loading would have been possible had the drains been doubled in number.

No wellpoints employed

The California procedure involves the driving of wellpoints into the muck between the sand drains and connecting these points with gages to measure the pore pressure in the muck as loading proceeds. Suitable wellpoints could not be obtained, so it was necessary to rely upon visual observation of the embankment and study of the time settlement curves to control the rate of loading.

Plans called for a roadway width of 64 ft., a surfacing 51 ft. wide, three to-one slopes on the embankment, and a grade-line about 8 ft. above mean low tide. Work was started in November, 1942, and the clay blanket was completed in a month. The original plan was to hold the maximum thickness of the clay layer to 2 ft., but 6 ft. was added for some sections before the surface could be maintained at marsh level.

PRECAST CONCRETE POINTS closed the lower end of the pipe mandrel and remained at bottom of vertical sand drain. The portable pile-driving rig at right drove the 12-in. dia. mandrel.

Installation of the sand drains began in December, 1942. A 40-ft. length of 12-in. steel pipe served as a mandrel, one section being used for the entire project. Conical concrete points were fitted into the lower end of the mandrel (Fig. 3), and these points remained at the bottom of the sand drain when the pipe was withdrawn.

A wooden punch driven to a depth of about 6 ft. was used to start the mandrel. After the punch was pulled, the concrete point was inserted and the mandrel easily drove the point to the full 40-ft. depth, except on a few drains where hard clay was reached at about 27 ft. Next the mandrel was filled with wet sand and the pipe withdrawn, leaving the sand and concrete point in place. In all, 1,492 drains totalling 57,685 lin. ft. were placed at a cost of $0.93 per ft., the drains were completed in March 1943.

Natural sands meeting the coarse grading of the California specifications could not be located locally to fill the drains, and since the soft silty material to be drained indicated the desirability of using a finer material, a natural local sand was used. This sand passed the ½-in. sieve and 85 percent was retained on the No. 50 sieve. It had a high permeability.

The sand was thoroughly dried on the first drains constructed, but the dry material bridged in the steel casing and would not start to drop until the pipe had been pulled about 20 ft. Saturating the sand with water solved this problem. The sand was loaded into a truck-mounted mixer by wheelbarrows operating on a portable ramp, sufficient water added, and, after a brief mixing period, the sand was discharged through a chute into the casing.

In April, 1943, samples of the muck-peat foundation material were studied in the laboratory. Undisturbed samples were taken at 10-ft. intervals vertically from borings made at twelve points along the project. Tests were made for moisture content, specific gravity, unit weight, shear, gradation, consolidation, and unconfined compression. This work showed the average moisture content of the muck-peat was about 400 percent its dry weight, which was approximately 20 lb. per cu. ft.

Shear strength of the muck was found to be negligible, the material failing of its own weight when unconfined. When consolidated with a pressure of 2,000 lb. per sq. ft., the shearing strength was also low. However, consolidation tests with a model made up from the muck showed that with vertical sand drains the material would consolidate twice as fast as without them. The depth of sand fill required to provide stability was predicted to be 10 to 19 ft., depending on the thickness of the muck-peat layer. These predictions were close to the actual depth required.

Work of placing the sand fill

FINISHED ROAD, surfaced with flexible pavement, has proven stable under several months of heavy use by commercial and private vehicles.

started in February, 1943. The fill was placed 95 ft. wide in 1-ft. layers, except for the first 6 in. layer over the tops of the drains. In May the fill on a 200-ft. section dropped about 1 ft. on the south side of the road and there was some movement on the north side. Filling was stopped for a week and then gradually resumed.

Uniform settlement occurs

Some 44,000 cu. yd. of compacted fill—or an embankment uniformly 3 to 4 ft. above the marsh level—had been applied up to July 1943, when operations had to be suspended. During the 11 months of inactivity on the job, the road was closed to vehicular traffic and the fill remained about 3 ft. above marsh level, although at one point it had settled below high tide level. Transverse settlement was uniform and there was no bulging of the surface of the marsh beyond the toe of the slope. Settlement records were obtained by weekly readings at 50-ft. stations along the center line of the project and referenced to the top of the clay blanket.

Recognizing the necessity for slow and carefully controlled application of the remaining required sand fill, engineers awarded three small contracts between June 1944, and July, 1945, calling for 61,200 cu. yd. of fill. After this material had been placed, a thorough study of all the settlement records was made to determine the amount of sand fill to apply during the last contract. A time-settlement chart was made for numerous stations and the amount of additional fill required computed, 50 percent being added for safety. This material, which totaled 15,700 cu. yd. was added during the last four months of 1945.

During the first three months of 1946 the roadway was opened to traffic and kept under continuous observation. Little settlement was noted, and it was decided to put down a semi-permanent surfacing consisting of a water-bound macadam base and a road-mixed sand-asphalt top 2.2 in. thick that called for 3.0 gal. of emulsified asphalt per sq. yd. The shoulders and slopes of the sand embankment were surfaced with a heavy clay blanket to prevent erosion by rain and pedestrian traffic.

The project was completed in August, 1946, and has been under heavy traffic since that date. Elevations taken in April, 1947, showed that the average height of the fill was 8.3 ft. above mean low tide and that the settlement from March, 1945, to April, 1947, had averaged 9 in. Serious difficulty from future settlement appears unlikely.

Use of a clay blanket below the fill and the selection of a sand fill for the entire depth of the embankment above this blanket are two elements believed to be responsible for the successful completion of the project. It is felt that without the clay blanket the soft muck would have pushed up through the sand fill and caused the abandonment of this type of construction.

The depth of settlement of the top of the clay blanket ranged from 4.5 to 18 ft. and averaged 13 ft. below the surface of the marsh. In view of this great settlement, it appears doubtful that use of only a 2-ft. thickness of sand above the top of the drains would have proven an effective horizontal drain. It must also be pointed out that under slow loading the muck-peat compacted with little lateral movement and no bulging of the surface of the adjacent area.

Cost of the project was $348,304.49, or $18.33 per sq. yd., for the 95-ft. width of stabilized fill.

Use of vertical sand drains was suggested to the Puerto Rican officials by A. C. Clark, Puerto Rican district engineer in the Public Roads Administration. O. J. Porter, formerly of the California Highway Department, offered valuable suggestions.

Arundel Corp., Consolidated Engineering Co., and Hardaway Contracting Co., were contractors on the early work, which was for the Tenth U. S. Naval District under the supervision of Capt. J. C. Gebhard, CEC, USN, and Comdr. J. G. Dodd, CEC, USN. The last operations were executed by force account by the Puerto Rico Department of the Interior with Manuel Saldana, resident engineer, and Capt. Perez, assistant. The laboratory tests were performed by E. K. Tan, soils specialist of the Madigan-Hyland Co. Ltd. The writer was PRA's district engineer for Puerto Rico and the Virgin Islands during construction.

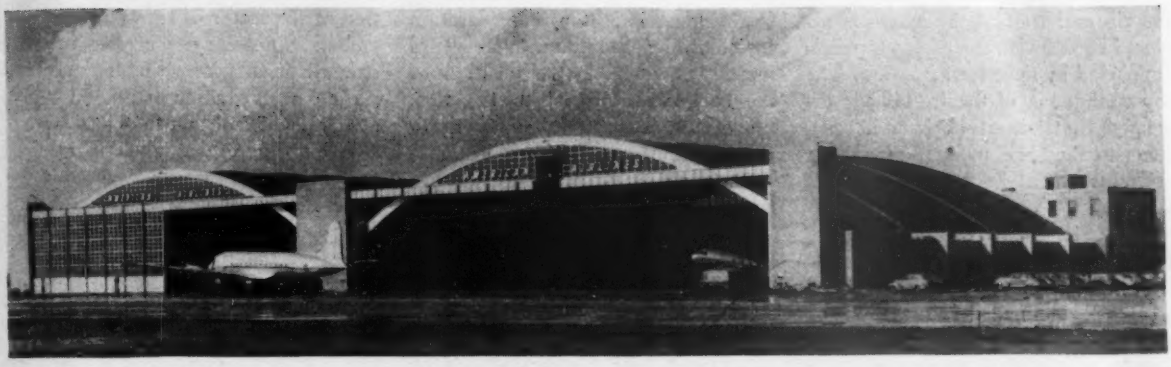


FIG. 1. TWIN ARCH HANGARS in Chicago have floors 257 x 175 ft. The leanto, rear and side, provides office space.

Thin-Shell Arch Hangars Span 257 Ft.

Boyd G. Anderson
Designing Engineer, Ammann & Whitney, Consulting Engineers
New York, N. Y.

PROPORTIONING of ribs and shape of shell of the twin American Airlines hangars at the Chicago Municipal Airport are unprecedented for this type of building. The structures are of reinforced concrete barrel-arch construction, each with a shell 3½ in. thick and ribs spanning 257 ft. The ribs are shaped to follow the funicular curve for dead load and provide a clear height at midspan of 58.4 ft. and 16 ft. at buttresses.

The twin hangars, each 175 ft. by 281 ft., share a central buttress (Fig. 1) and have an attached three-story leanto that provides 100,000 sq. ft. of additional floor space (Fig. 1). A portion of the leanto framing is integral and acts with the hangar structure.

Before the final selection of construction materials, a comparative analysis was made of different types of roof framing in concrete and in steel, considering fixed and hinged steel arches composed of either rolled-beam sections or sections with solid, latticed or Vierendeel webs. The comparisons also included both welded and riveted connections. As would be expected, the particular conditions of high thrust and requirements for rib flexibility had a marked effect on the framing offering the greatest economy.

Costwise, unfireproofed steel construction showed no economy over concrete framing, and fireproofed steel framing was considerably more expensive. Advantages of fireproofness, availability of materials, minimum maintenance costs and better conditions for lighting and cleanliness resulted in the choice of concrete.

Further comparisons of steel and concrete framing showed that, by maintaining minimum stiffness, the concrete arches could be made more flexible than economically feasible for steel ribs. Furthermore, the small unit footing pressures and ample flexibility of the slender concrete ribs permitted the use of fixed concrete arches in place of the less economical hinged steel arches often used for structures founded on poor materials.

Rib and slab dimensions

The final design calls for a thin, reinforced-concrete shell stiffened by monolithic ribs (Fig. 2). The shell is 3½ in. thick with the exception of the areas immediately adjacent to the ribs and edge beams. Longitudinally, the shell depth is increased from 3½ in. beginning at a point 4 ft. from each rib, to 5½ in. at the rib. In the plane of the arch, the shell varies from 3½ in. at a point 15 ft. above the edge beams, to 6 in. at these beams.

There are seven ribs in each hangar, spaced 29 ft. on centers, with a depth varying from 38 in. at midspan to a maximum of 50 in. at the abutments. The ribs are 22 in. wide, with alternate ribs split vertically into two 11 in. wide sections for construction purposes. All ribs spring from solid concrete buttresses.

Exterior buttresses bear on continuous spread footings, while those in the interior generally have separate footing pads. At one end, an interior buttress rests on a 28-ft. deep boiler room wall.

The maximum allowable soil pressures were adopted after an investigation of the soil capacity and probable footing settlement by Prof. Donald M. Burmister of Columbia University. A conservative loading on the medium-hard yellow-brown clay resulted in the use of a dead-load pressure of 1.2 tons per sq. ft. and a maximum design pressure of 1.6, t. s. f., except for an increase in allowable pressure to 2.2 t. s. f. under unbalanced construction loads.

Steel framing was used at both the front and rear ends of the hangars. At the front, the steel guides forming the top support for the sliding doors cantilever from the shell structure by means of L-shaped steel frames designed for minimum encroachment on the hangar space. The brackets also act as the framing supports for the glass closure above the doors A tailgate door permits a plane-tail height of 56 ft.

At the rear, the closure between

the rib and roof of the leanto is accomplished by means of glass panels supported by light steel framing. The top connection of the framing is arranged to transmit horizontal reactions to the shell without restricting arch movement in the plane of the rib.

The axis of each rib is shaped to coincide with the funicular curve for dead load, practically eliminating dead-load moments. Elimination of these moments lessens the distortion due to plastic flow under long-time loading and enables smaller ribs to be used.

This last is a major advantage in structures of this type. Bending moments due to shrinkage, temperature, rib shortening and abutment displacement are serious factors in long, flat arches, and these moments are directly proportional to the moment of inertia. Since some reduction of the moment of inertia is accomplished by diminishing the depth of the crown section, the ribs of the American Airlines hangar were proportioned to have a small, almost uniform depth from the crown to the quarter point. From the quarter point to the springing line, however, the depth was increased as necessary. This variation resulted in fairly uniform concrete stresses throughout and in improved appearance.

The most important consideration in obtaining minimum moment of inertia, however, is the position of the shell with respect to the ribs. Since the ribs are subject both to positive and negative bending moments, and since concrete slabs are not capable of taking appreciable tensile stresses, the ribs must be given sufficient strength as rectangular sections to resist arch bending. Thus, the shell does not contribute to the critical bending strength. Yet, unless it is placed near the neutral axis of the ribs, it increases the overall stiffness of the arches and, consequently, the stresses that the ribs must resist due to volume changes and displacements of the abutment.

Slab centrally located

The ribs of the hangar were reduced, therefore, to the minimum size permitted by buckling stability and the shell was placed at their centerline. Still, the effects of shrinkage, temperature change, rib shortening and abutment displacement were as much as 90 percent of the live-load moment at the springing line and 110 percent at the crown. The same rib with the shell moved from the neutral axis to the top or bottom of the rib would be much stiffer, doubling the moments at the crown and springing line. This would result in the reduction of the factor of safety to a small value. Since any increase in rib strength is offset by the increase in rib moments due to increased stiffness, it is evident that the most favorable location of the shell is at the neutral axis of the rib.

Beside the important effect of reducing the moment of inertia, a shell placed at the centerline of the ribs prevents participation of the slab in rib flexure. A slab placed at the top or bottom of a rib will act as the flange of a T-beam. It will carry a stress equal to that in the outer fibers of the rib. Because the slab is curved, a radial force equal to the unbalanced radial components of slab stress is required for equilibrium, and this resisting radial force is supplied by an induced cross-bending.

While the proportion of added shell stresses due to this cross-bending varies for different designs, cross bending may double the live-load bending stress in the shell for hangars of proportions similar to the ones under discussion. Such stressing of the shell by rib bending is eliminated by placing the slab at the center of the rib.

Use of flexible ribs requires an accurate determination of stresses. For this purpose, the ordinary elastic theory of arch design is inadequate, underestimating the rib stress and

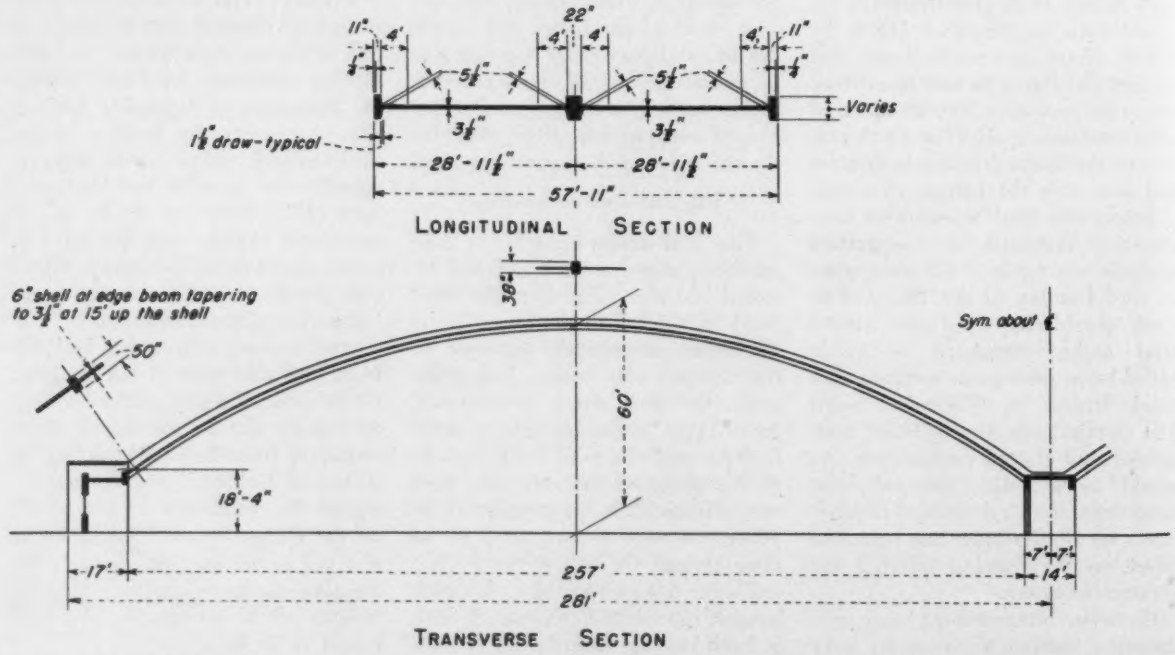


FIG. 2. SECTIONS through one hangar. The shell is mostly 3½ in. thick and the ribs only 38 in. deep at the crown.

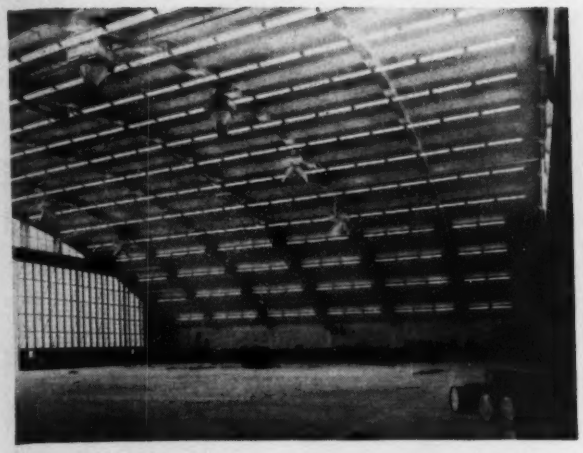


FIG. 3. ARCH RIBS project below, as well as above the roof slab, but provide 58.4-ft. clearance at the crown.

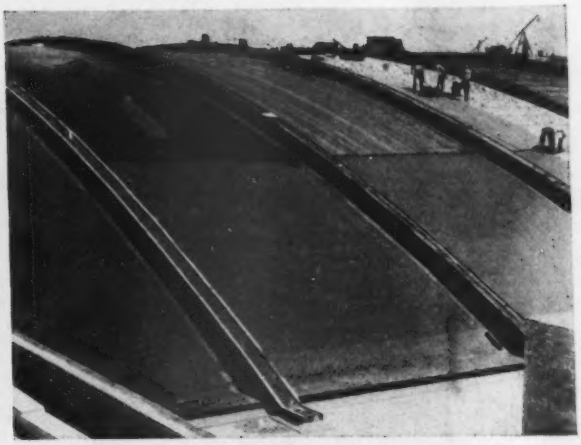


FIG. 4. OVER THE SHELL AND RIBS are applied 1-in. thick fiberboard insulation and 3-ply built-up roofing.

yielding misleading conclusions as to the stability and capacity of the structure. To arrive at an accurate estimate of rib capacity, it is necessary to use a design method that takes into account eccentricities of the thrust about the deflected position of the rib.

Because the ribs vary in curvature and moment of inertia, a direct mathematical solution is not practicable and the effect of deflections was evaluated by a method of successive approximations.

To obtain maximum unit stresses, loading combinations were assumed as follows: A. Dead load, abutment displacement, and temperature. B. Group A and live load. C. Group B and ½ wind load. D. Group A, wind and ½ live load.

Influence lines determined the critical loading position for the various arch sections, thus giving the maximum effect for the 25 p.s.f. live load. Allowance for such unbalanced loadings is necessary, for field observations show that snow load varies in intensity and distribution at different points on a barrel arch.

To obtain the distribution of wind loads, data from wind tests on models having similar height-breadth proportions were used. The design intensity was taken as 90 mph., yielding a velocity pressure of 21 psf., plus 10 psf. pressure or suction normal to the roof surface to provide for variations in internal pressure.

Temperature loadings included the estimated effect of a plus or minus 70 deg. F. differential between the top and bottom of the rib, as well as a plus or minus 30 deg. F. average change in the rib. Such small ranges of average temperature may be used if the ribs as well as the slab are insulated. The insulation is helpful also in reducing the temperature differential between the heated bottom surface and the exposed top of the rib. The additional cost of insulating the ribs of the Chicago hangar was small because the rib area above the shell is small (Fig. 4).

No increase was made in allowable unit stresses since the high moment-to-thrust ratio of the temporary loadings resulted in a non-linear drop in the factor of safety. Instead, estimated limit loads were established for each loading condition, and the proportions of the combinations were varied to give the critical stress condition in the structure.

Determination of secondary stress for each loading combination was carried through a sufficient number of cycles to prove the rib stable, as well as to provide the additional moment due to rib deflection. In these calculations, because of the non-linear effect of loading on the secondary stress, it was necessary to find the effect of an entire combination, including the factor of safety, rather than to add the separate effect of each individual load forming the combination.

Interaction of ribs and slab

Attention was also given to the interaction of the monolithic arched slab and rib. The proportion of arch thrust carried by either the slab or the ribs is indeterminate because of the uncertainty of the volume changes due to temperature and shrinkage; but limiting assumptions may be made. In calculating the amount of tension steel required in the ribs due to bending, it may be assumed that the arch thrust is shared by the slab and the ribs, but that all the bending is resisted by the ribs. To assure sufficient strength in compression, the ribs were checked for their ability to carry the entire thrust.

Because the final economy of the structure depends on construction as well as material costs, an investigation was made to determine the effect on construction costs of placing the shell at the centerline of the rib instead of the bottom. For the small partly protruding ribs of the Chicago hangar, it was found that the additional costs of formwork and jacking below the shell is balanced by savings in the cost of the floating formwork above the shell, which must be stripped, moved and set each time the falsework is moved to a new position.

The twin hangars were built for American Airlines under the general direction of Glenn E. Markt, director of airports and buildings. The general contractor was Corbetta Construction Co. Ammann and Whitney, consulting engineers, designed the structure and supervised construction, in association with Aymar Embury II, architect, and Chauncey L. Chase, consulting engineer on utilities.

Details of the methods used in constructing the hangars are given in a subsequent article.

COMMUNICATION between office and field was facilitated by radio on San Diego Aqueduct construction. Lt. D. A. Gray, CEC USNR, resident officer in charge, southern division, talks from his office to an assistant on the job, H. J. Dickinson, division engineer.

Radio on the San Diego Aqueduct

R. D. Thorson
Commander, CEC USN
Resident Officer in Charge San Diego Aqueduct
San Diego, Calif.

COMMUNICATIONS were made easier and construction progress expedited by use of three radio systems on the construction of the San Diego Aqueduct, recently completed in southern California (*ENR* Mar. 6, 1947, vol. p. 362). Two of these systems were used by contractors to report accidents and schedule work and equipment. The other was used by Navy resident engineers and inspectors.

The aqueduct is located in a mountainous and sparsely settled region with few intersecting roads and practically no available telephonic communication. Thus, where radio was not available, the summoning of aid in case of an equipment breakdown or serious personal injury was a time-consuming process. Radio also prevented some delays due to material shortages.

At peak of construction operations, seven contracts were in progress at about fifteen different locations along the 72-mile line of the aqueduct. The use of radio communication enabled just six Navy survey parties to maintain the necessary control work. For example, on the days when the surveyors were scheduled to furnish line and grade at the heading of one of the tunnels, the supervisor of surveys would radio the tunnel to obtain the contractor's plan of operations for that day. From this information the work of the survey party could be scheduled so that neither the party nor the contractor's force would be unnecessarily delayed.

Steel rib supports for heading

Frequently the miners encountered unstable ground at the tunnel heading, requiring the installation of steel rib supports. The services of a survey party would then be urgently needed to furnish line and grade for these supports. Through the use of radio, it was possible to have a party on its way to the tunnel within a few minutes.

Field superintendents for pipeline contractors were also able to contact the supervisor of surveys by radio when necessary. A daily schedule of the field location of each survey party made it possible to provide survey services on comparatively short notice.

Two of the project contractors, J. S. Barrett and United Concrete Pipe Corp., also used radio to advantage in their operations. For example, forces engaged in trench excavation by dragline often encountered hard rock, water, or other unsatisfactory conditions at unexpected locations. This required the reassignment of excavating equipment and men to other locations pending drilling and shooting of the rock or dewatering of the trench. Such reassignment was effected by radio.

Sending for assistance and spare parts as soon as equipment breakdowns occurred enabled repairs to be made more rapidly and thus saved considerable time and made possible greater use of the equipment. Also by this method the contractors were able to dispatch mobile equipment such as trucks, bulldozers and carryalls, to locations where they were more urgently required. This cut down the amount of equipment necessary to conduct the work efficiently.

EQUIPMENT for mobile radio units easily fit available vehicles. Box on contractor's foreman's truck (left) carried all the equipment necessary. On Navy inspector's jeep it was easily mounted in the back seat.

As would be expected, two-way radio communications proved invaluable in summoning aid in cases of serious accident. In one case where an unexploded charge of dynamite was accidently detonated by subsequent drilling operations, radio communication brought medical aid to a remote tunnel location two hours earlier than would have been possible by previously existing methods of communication.

Contractors using two-way radio equipment on the San Diego Aqueduct project were emphatic in their belief that it was imperative on a construction job of such magnitude and location. They felt that radio communication aided in reducing costs, speeded up operations and was instrumental in saving lives.

Some difficulty was experienced at times in the use of two-way, frequency modulated, short-wave type radios in the mountain regions traversed by the aqueduct. In these locations it was found necessary to operate the mobile units from a high location in order to communicate with the fixed stations because of the straight-line characteristics of high-frequency radio waves. Cliffs and mountains or other solid objects reflect such waves. This difficulty was overcome by maintaining call schedules and by having the mobile units contact the fixed station whenever they were at a high location.

A special Federal Communications Commission license was issued the contractors for use of radio. The authorization specified that the use was, primarily, to transmit communications pertaining to the safety of life and property and, secondarily, to transmit other essential communications required in connection with the construction of the San Diego Aqueduct project. Operators of the fixed stations were required to obtain a restricted radio-telephone operator's license issued by the FCC after qualifying by examination. Maintenance of contractors' equipment was accomplished by entering into a service contract with a local radio technician licensed by the FCC.

Number and cost of units

J. S. Barrett, contractor on four tunnels and several miles of aqueduct, had two fixed stations and eleven mobile units. The Navy had two fixed stations and seven mobile units. One of the Navy's fixed stations was located close to the contractor's office so that in effect the two systems were tied together. United Concrete Pipe Corp. maintained one fixed station and four mobile units for its work.

Estimated cost of the contractor's equipment including installation was $1,700 for each fixed station and $600 for each mobile station. Costs of maintenance were estimated at about $10 per month for all units.

The Navy construction of the San Diego Aqueduct project was under the cognizance of the Bureau of Yards & Docks. Rear Adm. J. J. Manning, CEC USN, was the chief of the Bureau of Yards & Docks, and Capt. A. K. Fogg, CEC USN, public works officer for the 11th Naval District, was officer in charge of construction. Project manager for J. S. Barrett was P. E. Conner. Harold F. Pope was project engineer for the United Concrete Pipe Corp.

Autobahnen Paving Study

The result of an elaborate study of the condition of the concrete pavements on the German Autobahnen, prepared by F. H. Jackson and Harold Allen of the Public Roads Administration, is published in the June, 1948 issue of *Public Roads*, the quarterly journal of the Public Roads Administration. Copies of the June issue can be obtained from the Superintendent of Documents, Washington 25, D. C., for 50c.

The report states that all of the structural defects that usually develop in concrete pavements in this country were found on the Autobahnen, but aside from frequently observed transverse cracking, defects such as joint spalling and faulting, settlement, etc., were not serious except in the Frankfurt area, where traffic is the heaviest. The comparative freedom of these German roads from structural defects is believed to be due primarily to the comparatively small amount of heavy truck traffic on them and to the comparatively mild climate.

A New Concept of Water Chlorination

Dean Gordon M. Fair of Harvard University explains conclusions resulting from some fundamental research on mechanism of water disinfection with chlorine.

IT IS INCORRECT to speak of disinfection of water by chlorine. Actually chlorine added to water is present for only a fleeting instant under practical conditions. It is hypochlorous acid, produced by hydrolysis, that exercises the major disinfecting action of chlorine solutions. This fundamental distinction between chlorine and hypochlorous acid was made by Gordon M. Fair, dean of the Graduate School of Engineering, Harvard University before the American Water Works Association which met recently in Atlantic City, N. J.

The report culminating several years of investigations was based on research conducted by Dean Fair, Drs. J. Carrell Morris, Shih Lu Chang, Ira Weil, and Robert P. Burden.

Pointing to new concepts that have emerged from detailed studies at Harvard, Dean Fair stated that when chlorine is dissolved in water, a reaction takes place to form hypochlorous acid and hydrogen and chloride ions. The reversible reaction is represented by the equation:

$$Cl_2 + H_2O \rightleftarrows HOCl + H^+ + Cl^- \quad (1)$$

Hypochlorous acid, it was said, then undergoes a further reaction, in which hydrogen and hypochlorite ions are produced:

$$HOCl \rightleftarrows H^+ + OCl^- \quad (2)$$

As this reaction is almost instantaneous and reversible, it may be represented by an equilibrium expression:

$$\frac{(H^+)\,(OCl^-)}{(HOCl)} = K \quad (3)$$

Expressions in parentheses stand for activities (about equal to molar concentrations) of the substances and K is the ionization constant that depends only on temperature, he said. Values of K compiled from researches on ionization of hypochlorous acid are:

Temperature °C	Temperature °F	K
0	32	2.0×10^{-8}
5	41	2.3×10^{-8}
10	50	2.6×10^{-8}
15	59	3.0×10^{-8}
20	68	3.3×10^{-8}
25	77	3.7×10^{-8}

Rearrangement of the ionization constant equation,

$$\frac{(OCl^-)}{(HOCl)} = \frac{K}{(H^+)} \quad (4)$$

shows that relative amounts of hypochlorous acid and hypochlorite ion in a solution of free chlorine are functions of hydrogen-ion activity or pH. Dean Fair pointed out that the sum of these two products is always determined in free-chlorine analyses.

The percentage of free chlorine present as undissociated hypochlorous acid at various pH values and a solution temperature of 20 deg. C. as well as the amount of free chlorine required to give one part per million of hypochlorous acid was reported as follows:

pH	*HOCl* (percent)	Free chlorine (ppm. per ppm. *HOCl*)
4	100	1.000
5	99.7	1.003
6	96.8	1.033
7	75.2	1.33
8	23.3	4.3
9	2.9	34.
10	0.30	331.
11	0.03	3,300.

Since hypochlorous acid is the principal disinfectant in chlorine solutions, the efficiency of the solutions was said to vary as a function of pH in much the same way as the percentage of hypochlorous acid.

Disinfection by hypochlorites

Hypochlorites (chloride of lime, calcium hypochlorite and bleach solution) in water produce reactions similar to those obtained with chlorine solutions. For example, calcium hypochlorite dissolved in water ionizes according to the equation:

$$Ca(OCl)_2 \rightleftarrows Ca^{++} + 2\,OCl^- \quad (5)$$

Hypochlorite ions then combine with hydrogen ions to form hypochlorous acid:

$$H^+ + OCl^- \rightleftarrows HOCl \quad (6)$$

While this reaction is the reverse of that shown by equation (2), the same equilibrium expression and constant hold and relative amounts of hypochlorous acid and hypochlorite ion at a given pH are exactly the same as for a chlorine solution. Dean Fair commented that addition of chlorine tends to lower initial pH but hypochlorite tends to raise it.

Chloramines affect strength

As hypochlorous acid reacts with ammonia and many organic amines frequently found in natural waters, the disinfecting action of chlorine solutions is modified by formation of chloramines. Like hypochlorous acid, chloramines retain the oxidizing capacity and standard tests (starch-iodide and orthotolidine) record chlorine combined with nitrogen plus free chlorine. But the disinfecting power of the solution is changed due to modification of the molecular nature of chlorine.

The most important reaction of chlorine and nitrogen compounds is that of hypochlorous acid and ammonia. As a result of the reaction, three compounds—monochloramine (NH_2Cl), dichloramine ($NHCl_2$), and nitrogen trichloride (NCl_3)—may be formed, Dean Fair said. However very little is known about the fundamental character or interrelation of reactions producing the three compounds.

Investigations of the ammonia-hypochlorous acid reactions in the Harvard laboratories have led to these conclusions:

1. Formation of chloramines is a step process represented by the equations:

$$NH_3 + HOCl \rightarrow NH_2Cl + H_2O \quad (7)$$
$$NH_2Cl + HOCl \rightarrow NHCl_2 + H_2O \quad (8)$$
$$NHCl_2 + HOCl \rightarrow NCl_3 + H_2O \quad (9)$$

2. The rate of monochloramine formation is closely dependent on pH of the solution. Monochloramine forms most quickly at a pH of 8.3 and less rapidly at higher and low pH values. For example, at a temperature of 25 deg. C., 99 percent of 0.8 ppm. chlorine and 0.32 ppm. ammonia-nitrogen react in about one minute at pH of 8 but at pH of 5 the reaction requires nearly 210 min. and at pH of 11 about 50 min. The rate of reaction also varies widely with temperature changes.

3. Dichloramine is formed at low pH values (5-6.5) and monochloramine at high pH (above 7.5). This is shown by the equilibrium reaction:

$$2\,NH_2Cl + H^+ \rightleftarrows NH_4^+ + NHCl_2 \quad (10)$$

Dean Fair remarked that an "excess of hydrogen ions should displace this reaction to the right, yielding greater

amounts of dichloramine at lower pH values." The equation predicts that relative proportions of mono-chloramine and dichloramine are influenced by excess ammonia present as well as by pH, a prediction that has been confirmed by spectrophotometric measurements.

In addition, the measurements give a value of 6.7×10^5 for the equilibrium constant in the equation:

$$K_{eq} = \frac{(NH^+_4)\,(NHCl_2)}{(H^+)\,(NH_2Cl)^2} \qquad (11)$$

Calculated with this constant, relative percentages of monochloramine and dichloramine at various pH values with a chlorine: ammonia-nitrogen weight ratio of 5:1 are:

pH	5	6	7	8	9
Chlorine as Dichloramine (%)	84	62	35	15	6

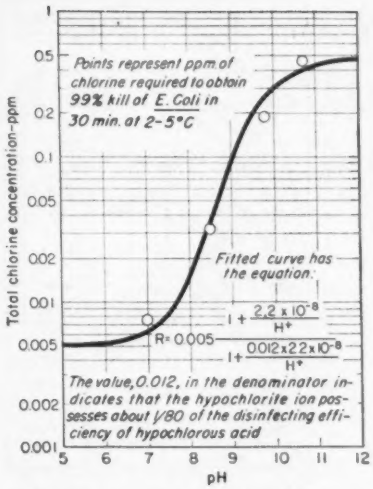
"Just as the disinfecting efficiency of free-chlorine solutions will vary with pH because of change in the hypochlorous-acid — hypochlorite -ion ratio," stated Dean Fair, " so that of chloramine solutions will vary with the dichloramine—monochloramine ratio."

Oxidizing chlorine reduced

A strong oxidizing agent, hypochlorous acid reacts with reducing substances, resulting in the so-called "chlorine demand." The chlorine atom gains electrons and is thereby changed into chloride ion or organic chloride to reduce the oxidizing properties and disinfecting power of the chlorine atom.

Substances in water that reduce chlorine are iron, manganese, nitrites, hydrogen sulphide and organic material. The reaction of inorganic substances is usually rapid and stoichiometric (in accordance with the laws of chemical composition) but that of organic material is generally slow. In the latter case its extent depends on excess concentration of available chlorine present. Organic chlorine demand, Dean Fair advised, can be estimated from the depth of color of natural waters because organic material is usually related to the color or stain. He emphasized that sufficient chlorine must be provided to satisfy reducing substances before reliable disinfection can be expected.

Ammonia and organic amines may exert chlorine demand in breakpoint reactions. This phenomenon, like the formation of chloramines, is of great importance in disinfection, he said, but virtually nothing of its fundamental chemistry is known.


Points represent ppm of chlorine required to obtain 99% kill of E. Coli in 30 min. at 2-5°C
Fitted curve has the equation:
$1 + \frac{2.2 \times 10^{-8}}{H^+}$
R = 0.005
$1 + \frac{0.012 \times 2.2 \times 10^{-8}}{H^+}$
The value, 0.012, in the denominator indicates that the hypochlorite ion possesses about 1/80 of the disinfecting efficiency of hypochlorous acid
Total chlorine concentration-ppm
pH

Variations in pH have an important effect on the required killing concentration of aqueous chlorine.

Experiments on breakpoint reactions now in progress have established several facts:

1. Rate of reaction is closely dependent on pH. The maximum rate occurs at pH of about 7.5 but at high and low pH values the reaction is much slower.
2. Dichloramine is probably one substance involved in breakpoint reactions.
3. Temperature only slightly affects the rate of reaction.
4. The rate of reaction is closely dependent on total concentration of dissolved salts.

Dean Fair declared that complexities of breakpoint reaction are so great that considerable work must be done before a consistent theoretical treatment can be achieved.

Biological reactions of chlorine

Recent research by David E. Green indicates that death of an organism results from a chemical reaction of hypochlorous acid with an enzyme system in the cell, essential to metabolic functioning (*Jour.* A.W.W.A. 38:1301, 1946). An enzyme found in practically all cells and necessary for utilization of glucose, *triosephosphate dehydrogenase*, is probably attacked in the reaction. Dean Fair added that attack on other enzymes is not excluded but this species is highly sensitive to oxidizing chlorine.

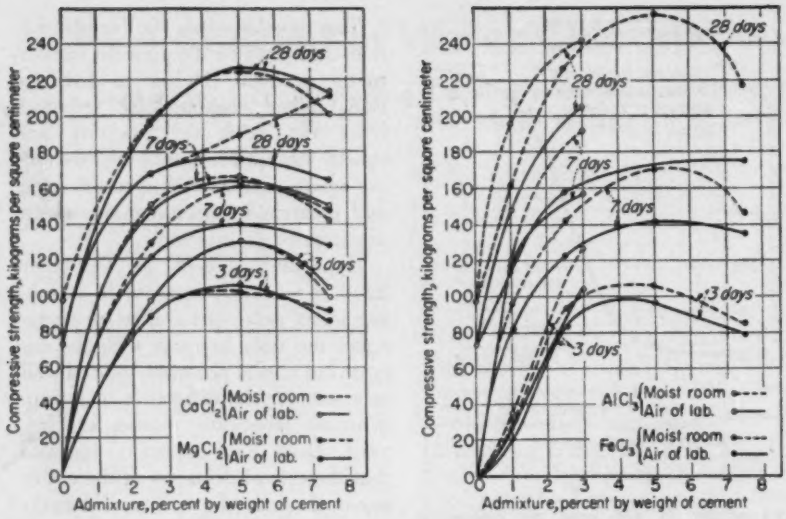
This explanation, he continued, does not provide a complete answer to the problem of chlorine disinfection. When enzymes are removed from the cells, the enzymes are equally susceptible to attack by oxidizing agents such as hydrogen peroxide and potassium permanganate, which are inferior disinfectants.

Hypochlorous acid, on the other hand, is markedly superior in attacking intact cells. The ability of the reagent not only to react with the enzyme but also to penetrate the cell wall accounts for the difference in action. Wartime laboratory studies at Harvard, Dean Fair reported, indicate that the rate of diffusion of the active agent through the cell wall largely determines rate of disinfection as well as relative efficiency of various disinfectants. Thus, the strong oxidizing power of hypochlorous acid, although essential, does not make it a superior disinfectant; it is superior because of its small size and electrical neutrality. It was said that this hypothesis must be confirmed by additional study of the rate of kill of organisms by various disinfectants and of variations in the rate under changing conditions.

Factors affecting disinfection

The efficiency of destruction of a particular type of organism is influenced by time of contact, concentration of organisms and disinfectant, temperature and nature of the disinfectant. For a through understanding of the disinfection process, dynamic studies in addition to the work of C. T. Butterfield and others (U. S. Public Health *Reports* 58:1837: 1943, 59:1661: 1944 and 61:157: 1946) are essential, he declared, to establish a satisfactory basis for theoretical calculations.

The total annual expenditures for chlorine plus the importance of the chemical in preventing water-borne disease justify the cost of all investigations that must yet be undertaken to acquire a complete understanding of this most important waterworks chemical, Dean Fair concluded. "No industry can long afford the luxury of ignorance even though it be tempered by accomplishment; neither can a profession that, like the waterworks profession, is so clearly devoted to protection and promotion of public health."


Compressive strength, kilograms per square centimeter
Admixture, percent by weight of cement
28 days
7 days
3 days
$CaCl_2$ {Moist room / Air of lab.
$MgCl_2$ {Moist room / Air of lab.
$AlCl_3$ {Moist room / Air of lab.
$FeCl_3$ {Moist room / Air of lab.

TESTS OF CONCRETE containing chloride admixtures show that . . .

Calcium Chloride Counteracts Organic Impurities in Sand

Inge Lyse
Research Professor, Norway Institute of Technology
Trondheim, Norway

NATURAL SAND very often contains organic matter which, even when present in minute quantities, will lower the strength of concrete and slow down or prevent its set. Since a great many natural sands in Norway contain organic matter in smaller or larger amounts, it has been very important to find a cure for reducing the detrimental effect of these impurities. A comprehensive series of studies has been carried out over the last few years at the concrete laboratory of Norway's Institute of Technology in an attempt to solve this problem.

Calcium chloride is known to accelerate the setting and hardening of concrete, and it, therefore, was selected as one of the chemicals that might counteract the detrimental effect of the organic impurities. Preliminary studies showed, in fact, that calcium chloride was beneficial, and suggested that similar chemicals might also be useful.

A sand containing a large amount of organic impurities was selected for the more important part of the investigation; this sand showed entirely black color when tested by the ordinary NaOH method. Concrete made with this sand had no strength at 3 or 7 days, and even at 28 days the strength was very low. Yet with the addition of admixtures of chlorides the strength became nearly normal.

The accompanying graphs indicate how strengths are affected by $CaCl_2$, $MgCl_2$, $AlCl_3$ and $FeCl_3$. It is noted that the calcium chloride, in general, gave better results than the other chemicals used. And since calcium chloride is readily available at relatively low cost, it was considered to be the most practical admixture.

Lean mixes are not affected

For concrete mixes of the range ordinarily used in building construction, the calcium chloride admixture practically eliminated the effect of the organic impurities, but in very lean mixes it was not so effective.

For best results, as far as strength is concerned, the amount of admixture should be between 3 and 5 percent of the weight of the cement in the mix. But such a large percentage of calcium chloride seems somewhat too great when the durability of the concrete is of importance. Some freezing and thawing tests check this opinion. Accordingly, it is recommended that the amount of the admixture should not exceed 2 percent of the weight of the cement in order that the durability of the concrete be maintained as high as possible.

Foreign Languages

The following, written by A. E. Cummings, Director of Research of Raymond Concrete Pile Co., first appeared in the Raymond Record, a paper devoted to the interests of Raymond personnel.

It has been said that the immense value of becoming acquainted with a foreign language is that we are thereby led into a new world of tradition and thought and feeling. There can be no question as to the truth of this statement and it is not possible to overlook the cultural advantages which come from the ability to read and converse in a foreign tongue.

However, in addition to its cultural value, the knowledge of a second language has definite professional advantages in the field of engineering as well as commercial advantages in the world of business. Valuable work in all fields of science and engineering is being done abroad but the results of the discoveries and developments made in foreign countries are not often published in the English language. The engineer who can read technical material in one or more foreign languages is much better able to keep abreast of engineering progress than is the engineer who can read only English.

In the world of business, the traveler who can talk intelligently and who can understand what he sees and hears in a foreign country is a much more valuable emissary than one who can communicate only in the English language.

Because of the increasing scope of foreign operations there is a growing need for us to be able to converse with and to understand the culture of foreign guests in our land or of our hosts in those lands in which we may be foreigners.

New Foundation for 350-Ton Crane

Commodore W. Mack Angas, (CEC) USN
Superintending Civil Engineer, Bureau of Yards and Docks
New York, N. Y.

DURING THE RECENT WAR, a new foundation became necessary for the 350-ton fitting-out crane at the Brooklyn Navy Yard. The successful transfer of this giant crane to the new foundation without prolonged shut down facilitated the completion of such important ships as the USS Missouri, insured the prompt restoration to service of a number of large vessels, among them the Richelieu, and expedited the loading of landing craft onto seagoing freighters for overseas shipment. The solution of this unusual foundation problem was a major contribution to victory in both Europe and the Pacific.

The 350-ton fitting out crane at the New York Naval Shipyard, popularly known as the Brooklyn Navy Yard, after being used to set the turrets and 16-in. guns of the USS *Iowa*, was found to have tipped and moved appreciably toward the face of the quay wall on which it stands. An investigation indicated that dredging for the accommodation of the *Iowa* had reduced the stability of the crane foundation so seriously that capacity loads could no longer be handled at maximum radius without danger of a disastrous failure.

Military and naval considerations demanded prompt and full restoration of the capacity of the crane without shutting it down for other than short and carefully scheduled periods.

The crane is of the revolving hammerhead type, and consists of a fixed octagonal tower of structural steel, surmounted by a roller path and roller train upon which revolves a huge hammerhead-shaped rotor carrying the load-lifting trolleys, hoists and operating mechanism.

The fixed tower of the crane was originally carried by a massive octagonal reinforced concrete foundation supported by timber piles from 40 to 70 ft. long, some of which were driven when the quay wall in front of the crane was built. The design of this old quay wall did not contemplate the incorporation of piles driven for the support of its relieving platform into a crane foundation. The driving of additional piles for the foundation was accompanied by considerable heaving of the ground around them and by heaving of some of the original piles, which were redriven. There was also appreciable outward movement to the quay wall. This led to a decision to strengthen the wall, after completion of the crane, by driving a line of steel master-beam piles in front of the wood sheet piling of the original construction.

The maximum design load on individual piles of the crane foundation was 20 tons. The piles were driven through 20 ft. of fill and 20 ft. of silt into a thick bed of alternate layers of fine sand, silt and clay, into which they penetrated from 5 to 20 ft. before bringing up to virtual refusal. This bed of sand, silt and clay is about 45 ft. thick and is underlain by a stratum of sand, gravel and boulders some 20 ft. thick. Below this there is a stratum of hard blue clay, and then bed rock at about 100 ft. below mean low water.

Settlement readings on points established on the crane foundation were started immediately after its completion in August, 1939. Between August and December, 1939, the foundation settled about ½ in. under the load imposed by the erection of the crane. This settlement was uni-

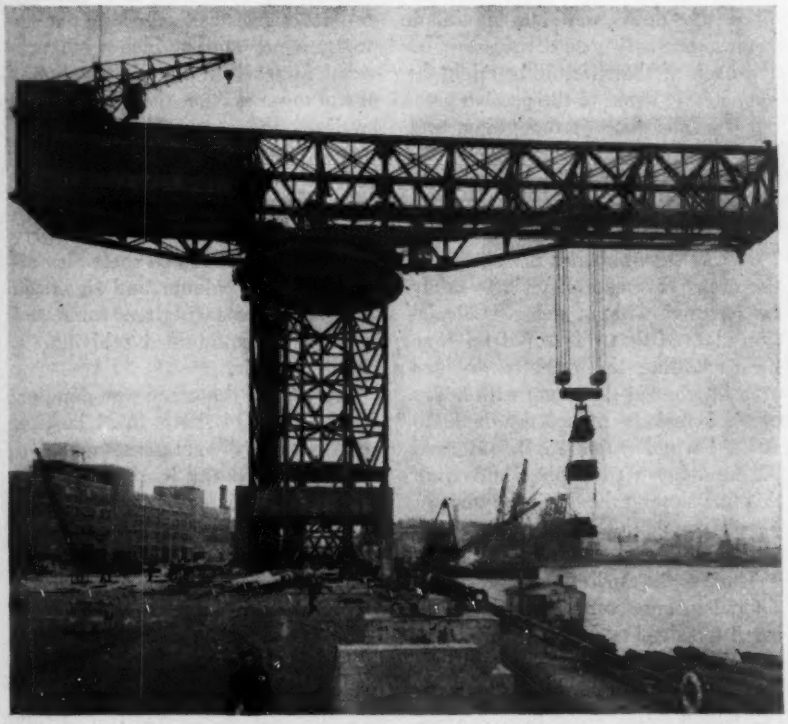


FIG. 1. TEST LOAD at 115-ft. radius on 350-ton crane after support of the crane was shifted from 50 ft. piles under octagonal tower to square portal resting on 100-ft. piles driven to a better supporting strata. Sections of the original tower beneath the portal were later removed.

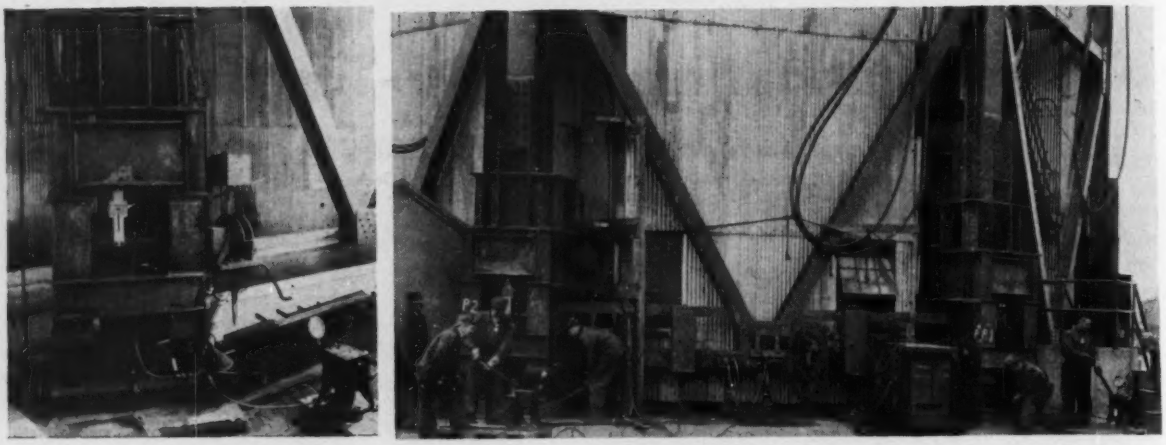


FIG. 2. JACKING ARRANGEMENT for lifting each of the eight tower legs. Calibrated scale and liquid lever indicator to other tower legs were used to assure raising at uniform rate.

form, there being no appreciable tilting or tipping. During strengthening of the quay wall, which involved the driving of 60-ft. long beam master piles (sheetpiles to which were riveted 18-in. wide flange-beams) the foundation settled further, and also tipped slightly toward the waterfront. In late 1940, when the quay wall was completed, the side of the foundation nearest the waterfront had settled a little more than 1 in., while on the opposite side it settled a little more than ½ in. Between March, 1940 and July, 1942, the progressive settlement of the foundation was not alarming, though differences between the settlement of the water and land sides increased to almost 1¼ in., with the water side down to a total of slightly more than 2 in.

In July, 1942, the slip in front of the crane was deepened to accommodate the USS Iowa. Excavation was carried down to a depth of 45 to 47 ft., sloping upward from a point 25 ft. outboard of the coping of the quay wall.

The turrets and guns were installed on the Iowa without incident or delay. Unfortunately, the large amount of gear and equipment temporarily stored about the crane during the outfitting of the Iowa interfered with taking elevations on the foundation for several months.

Elevations taken in December, 1942 showed the foundation had settled an additional 1¼ in. on the water side, making total settlement a trifle more than 3 in., and the entire unit had moved horizontally toward the water 1¾ in. since its completion in 1940. There had been no further appreciable settlement of the land side of the foundation.

The horizontal movement toward the water and the increase of the tilt to nearly 2½ in. in 56 ft. were danger signals that could not be ignored. A study, making reasonable assumptions as to the transfer of load from the piles to the earth supporting them, led to an estimate that when the crane was making a maximum lift over the quay wall at maximum radius, the active earth pressure on the back of the sheetpiling might be very nearly equal to the passive pressure on the face of the piling, and that the tie-backs at the top of the sheetpiles were probably overstressed.

Safety in operation restored

It was essential that the ability of the crane to make heavy lifts safely be restored without delay. Calculation showed that this could be done by backfilling the recently dredged area in front of the crane with heavy crushed rock to reduce the depth to 40 ft. beyond a line 25 ft. outboard of the quay wall coping and from this line sloping the fill at the steepest possible angle to the face of the sheetpiling.

The repair thus effected was considered incomplete and temporary as it left unsolved two serious problems. The first of these was to level the crane so that risk of trouble with the roller-path and king-pin bearing might be minimized. The second was to restore permanently the stability of the crane to a degree that would allow redredging in front of it to a depth of 45 ft. at mean low water.

Study indicated that a force of 400 tons would be sufficient to lift each of two adjacent columns under the crane so that it could be levelled by shimming. A welded structural steel "pick-up point" was attached to each column by riveting as the silicon steel of the original tower did not favor welding. An uplift point, a set of four 125-ton hydraulic jacks, and a single pump connected to a manifold and to a gage calibrated in pounds pressure per square inch were provided for each of the eight columns of the tower so that the operation of leveling the crane might, when started, be completed expeditiously and be redone as necessary.

Planed steel shim plates, 18 in. square, of varying thickness were provided. A graduated scale was attached to each column, and alongside the scales were gage glases connected by lines of liquid-filled tubing to a small reservoir.

Leveling of the crane was done on April 13 and 14, 1943, in 24 jacking and shimming operations none of which changed the level more than ¼ in. Maximum force required to lift any column was 340 tons. Fig. 2 shows the leveling equipment and procedure.

The work up to this point had restored the crane to complete usability but it had not attacked the underlying difficulty of inadequate subsurface structure which was responsible for the settlement and side movement.

In planning the new foundation, which was to restore the stability of the crane permanently, consideration

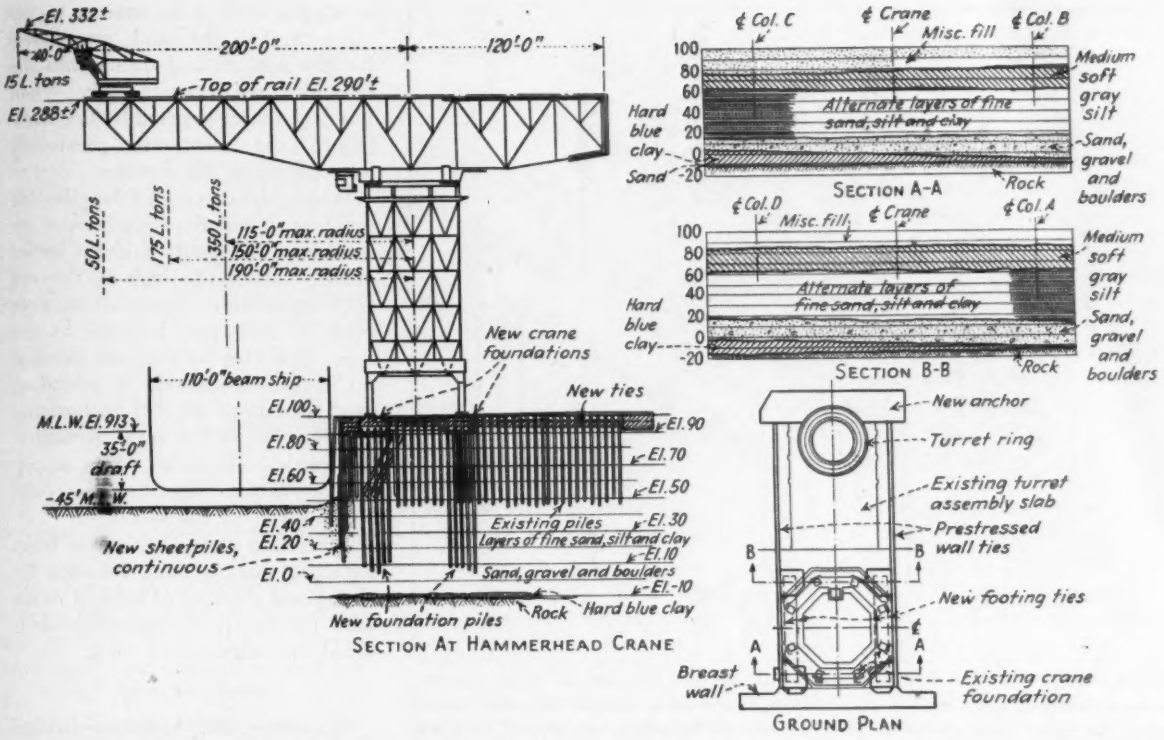


FIG. 3. THE NEW SUPPORT PILES were driven into sand gravel and boulders a few feet above rock. The earlier piles were founded in fine sand, silt and clay at a much higher elevation.

was given to the following procedures: (A) The quay wall might be strengthened sufficiently to prevent further serious settlement of the existing foundation. (B) An annular concrete girder, carried by long piles, might be built around the existing foundation and attached to it in such a way as to supplement it, if not give it complete support. (C) A new foundation might be built alongside the old one and the crane moved bodily to it. (D) Four deep foundations might be constructed at the corners of the square circumscribed about the octagonal tower and used to support a heavy structural steel portal to which the tower columns could be connected. That part of each column below the portal could then be removed, leaving the crane entirely independent of the original foundation.

Method A was rejected as a complete solution of the problem as it was believed that further settlement of the foundation would occur no matter how extensively the quay wall might be reinforced by the driving of longer and stronger sheet piles.

Method B, the construction of an annular foundation around the existing one to supplement and support it, would seriously interefere with the use of the crane for extended periods. Also, the type of the soil under the relatively short piles of the old foundation might leave a large and indeterminate weight of earth adhering to them which the longer piles of the new foundation would have to support.

Method C, which involved moving the crane bodily, was dismissed as too risky.

Method D, the provision of four deep foundations carrying a portal which would support the crane tower independently of the old foundation, was adopted. The quay wall in front of the crane should be strengthened by improving the tie-back system holding the tops of the sheetpiles and by supplementing the existing beam master piles with larger ones having sufficient toe hold to permit dredging in front of them to a depth of 45 ft. with safety.

Steel H-beam piles were selected for the new foundation. Estimates indicated that pile foundations would be materially cheaper than pneumatic caissons, and it was believed that the piles could be driven with less risk to the existing foundation than would be involved in sinking caissons in a material where obstructions were probable.

The construction first undertaken involved a heavily reinforced concrete breast wall girder extending 60 ft. on each side of the center of the crane. To resist the outward thrust of the sheetpiles against the girder, two tie-backs were run from it to a massive reinforced concrete anchor which was constructed inboard of the turret foundation as shown in Fig. 3.

The anchor, the breast wall girders, and the two tie-backs that connected them were constructed simultaneously. Each tie-back consisted of two 12-in. 74-lb. steel H-sections, reinforced with 6-in. 15½-lb. channels. The tie-backs were anchored into the breast wall girder by reinforcing rods bent into hairpin shape and welded to the steel beams.

The land ends of the tie-backs were left protruding through holes in the anchor. When the concrete of the breast wall girder and the anchor had gained sufficient strength, the tie-backs were simultaneously prestressed to about 480 kips each, half their design load, by means of four

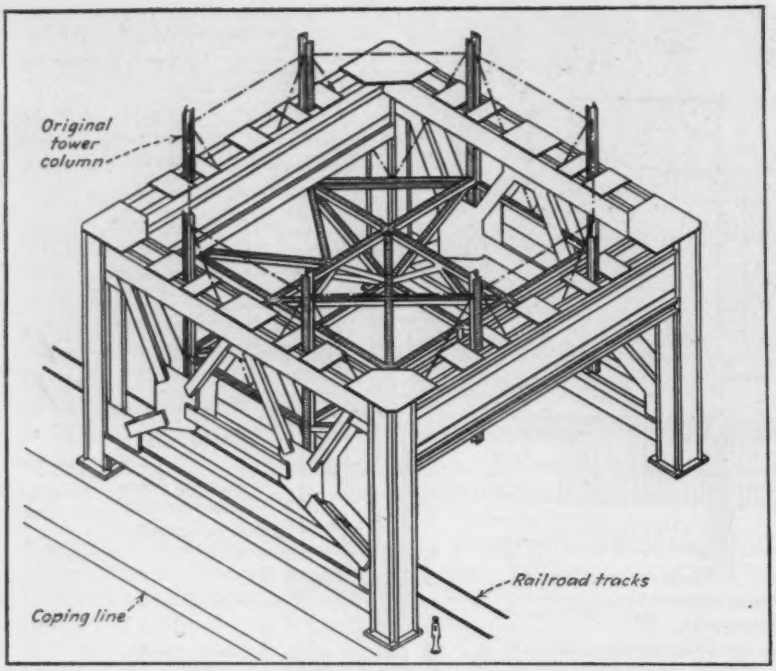


FIG. 4. TRUSSES were used in the sides of the new supporting frame parallel to the waterfront, but necessity of providing space for train and truck movement under the crane dictated use of plate girders in the other two sides. Original structures is shown shaded.

hydraulic jacks. The stress was held by shimming against prearranged bearings and then concreting the entire tie.

The design of the portal type foundation contemplated the use of 19 H-beam piles, spaced 3 ft. 6 in. both ways under each of columns A, B and D, and 28 piles under Column C. It was anticipated that the piles would bring up to refusal in the stratum of hard-packed sand, gravel and boulders which they would encounter at about 85 ft. below quay level and which under foundations A, B and D varied from 20 ft. to 24 ft. in thickness. Beneath this material there is a stratum of hard blue clay, which is slightly compressible, and below that bed rock.

Clay under foundations

Under foundations A, B and D the thickness of this clay is from 3 to 12 ft. At C, however, the stratum of hard-packed sand, gravel and boulders is only about 10 ft. thick while the layer of blue clay below it has a thickness of about 14 ft. The purpose of the nine additional piles under this foundation was to equalize slight prospective settlements. Maximum designed pile loads were 98 tons in footings A, B and D and 75.5 tons in footing C. All piles were 14 in. 89-lb. steel H sections.

Piles were welded after they were partly driven to secure the depth required. Lengths of 75 to 80 ft. were driven with a 1,600-lb. ram, 17-in. stroke, double-acting steam hammer. When the tips of these piles reached a point 75 ft. below quay level it required an average of 45 blows to drive them a foot. The driving rig with the small hammer moved to another footing while additional lengths of piles were welded to those already driven.

A second rig carrying a 5,000-lb. ram, 19-in. stroke double-acting hammer (11B3 McKiernan-Terry) striking 96 blows per minute completed driving the piles. At 85 ft. below quay level, where the tips of the piles entered the stratum of hard-packed sand, gravel and boulders, the driving resistance began to build up very rapidly. The required minimum resistance of 20 blows per inch for 98-ton bearing, was reached from three to nine inches above the final tip elevation, at which the minimum resistance was 29 blows per inch.

Selected piles in Footing C were driven to a resistance of about 50 blows per inch in an attempt to get them through the sand, gravel and boulder stratum and thence into the blue clay and down to rock. When this was found impossible, the additional piles mentioned previously were driven at this footing.

During the driving of the piles for the new foundations there was an additional, but nearly uniform, settlement of about one inch in the old crane foundation. Observations were made of vibration induced in the crane structure by the pile driving. An instrument capable of recording small vibrations showed no horizontal vibration of the crane structure, and vertical vibrations of an amplitude of .0003 in. No vibrations could be perceived by the senses.

Concreting of footings, done from a floating mixing plant, followed by setting and grouting of holding down bolts for the portal columns, completed the substructure work.

Transfer of crane

Meanwhile, the American Bridge Co., builder of the crane, had been awarded a contract for the construction of the portal, its erection, and the transfer of the crane to it from the old foundation.

Very careful measurements of the actual dimensions of the tower were made and templates prepared that showed precisely the location of each column. The design of the connection assemblies, which transmit the load from the eight tower columns to the girders and trusses of the portal, proved to be one of the most important details of the project. The octagonal shape of the tower made the planes of the column flanges diverge 22½ deg. from the planes of the portal girders and trusses. An effort was made to develop a connection assembly that would obviate the use of bent plates, but space limitations made this impracticable, and assemblies using bent plates, as shown on Fig. 5, were adopted.

In designing the connection assemblies, torsional stresses were considered. All principal stress-carrying connections of the assemblies and all other main connections of the portal were riveted. Space limitations required the use of turned bolts for some connections carrying secondary stresses. Welding was employed for other less important connections.

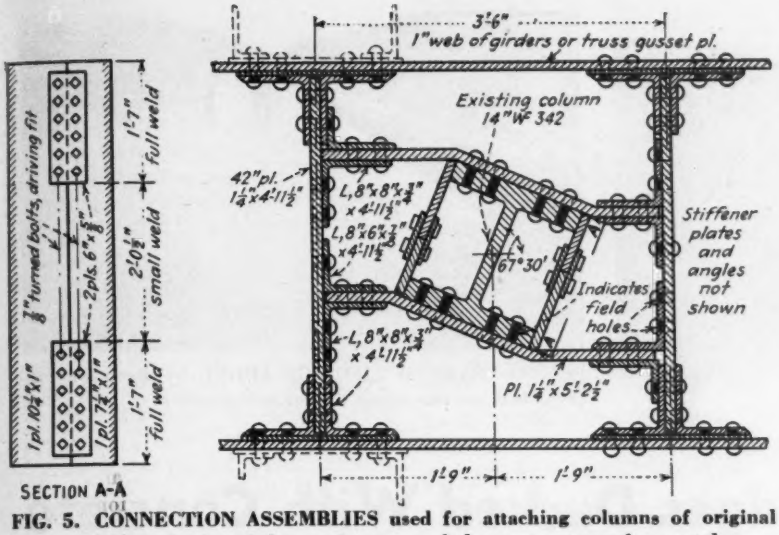


FIG. 5. CONNECTION ASSEMBLIES used for attaching columns of original octagonal tower to the girders and trusses of the new rectangular portal.

An important consideration in designing the connection assemblies was the method by which the tower load was to be transferred from the old foundation to the new portal frame. Several methods were discussed, the one finally adopted being suggested by the American Bridge Co.

This was: (1) to attach the connection assemblies to the eight tower columns and to erect the portal without riveting the connection assemblies to its girders and trusses or drilling the field holes in the connection assemblies; (2) to move those parts of the crane required to be positioned so as to produce equal loads in all eight tower columns; (3) to drill field holes in the connection assemblies for the rivets; (4) to drive the rivets while the eight columns of the tower continued to rest on the old foundation; (5) to jack up the columns, two at a time, sufficiently to permit the removal of the shims from beneath them; and (6) to burn off and remove the portions of the tower columns below the connection assemblies, leaving the crane entirely independent of the old foundation, and supported only by the new deep foundations and the portal.

This procedure was followed successfully. Bottom chords of the trusses were temporarily omitted, and girders and trusses were riveted to the eight connection assemblies that had previously been attached to the columns.

In the jacking operation involved in the transfer it was necesary to lift and distort not only the steelwork of the original tower but also the heavy frame of the new portal. To lift two adjacent columns jacking pressure was brought up to a force of 460 tons at each, but it was found that shims were not free. Pressure was then pumped up in the jacks under a column on each side of the two being lifted. When a force of 300 tons was reached, while 460 tons was maintained on the first two, the shims under the latter columns were freed and removed. The operation was repeated until the load of each tower column was transferred to the new portal frame. The pick-up assemblies were removed, and the chords and lower diagonals of the trusses were installed.

With the portal thus completed, precise determinations were made of the elevations of the tops and bottoms of the tower columns and points on the roller path under various conditions, the most severe being produced by revolving the crane with a 350-ton load at maximum radius. No serious deviations from anticipated deflections were noted.

With the crane thus carried by its new foundation, the work of supplementing the sheetpiling of the quay wall with longer beam master piles could go forward. The crushed rock berm in front of the quay was removed, while master piles were driven to the same stratum of sand, gravel and boulders as the piles carrying the crane foundation. During the driving of the long beam master piles, the two new portal footings near them settled about ⅛ in. No appreciable settlement has since occurred.

Investigation of the stability of the old foundation and the design of the new one was done by the Dry Dock Engineers of New York who were called in as consultants when the serious tilting of the old foundation was discovered. F. A. Harris, A. L. Parsons, C. M. Spofford, John Ayer, E. E. Halmos, and William Mueser of this organization gave the project much personal attention during its critical phases. General contractors for the new foundations and allied work were "The Contractors for Dry Docks," then engaged in other important work at the Navy Yard. John S. Macdonald was project manager at the inception of the project and later was succeeded by Fred W. Smith. John Malcolm and Leonard Van Houten were, respectively, the superintendent and engineer for the contractors.

The work was done under the general direction of the Bureau of Yards and Docks, of the Navy Department, of which Admiral Ben Moreell was then chief. The writer, as public works officer of the shipyard, was the officer-in-charge of the work in the field when the project was undertaken, and was later succeeded by Captain R. R. Yates (CEC) USN (Ret.). Captain E. B. Keating (CEC) USN and Comdr. E. M. Shanley (CEC) USNR as resident officers in charge of the contract contributed much to the success of the undertaking.

Deepening the berth at crane can, of course, be attacked as most unwise, inasmuch as it precipitated the necessity of constructing the new crane foundation. For this decision, the writer accepts responsibility. On the other hand, the decision was one which appreciably hastened the completion of the battleship Iowa at a critical phase of the Pacific war. In the light of subsequent events, dredging the berth may thus be defended as involving a justifiable risk, which was accepted and taken successfully. The final outcome of the entire affair was to furnish a permanently stable foundation for an important piece of equipment that had been carried by a foundation of doubtful stability.

ALABAMA BRIDGE is almost gone, its timber handrails rotted and untreated decking in disrepair . . .

BUT 20 YEARS OF LIFE ARE ADDED by placing a concrete deck on the sound timber substructure.

Old Timber Bridges Decked With Concrete

AN EXPERIMENT in low-cost, permanent re-decking of old timber bridges on secondary highways in Alabama, launched last year, proved successful on all points. It required no hard-to-get timber, permitted year-around rehabilitation of the bridges without interrupting traffic, employed chiefly low-cost convict labor under supervision of the State Highway Department's maintenance division, increased roadway width to 24 ft. and the design strength to an H-15 loading —all at a cost considerably lower than any suggested alternate method of bridge-rehabilitation.

In principle, the work was an outgrowth of the department's experience during the past 20 years of combining reinforced concrete roadway slab with treated timber stringers and substructure.

Bridges rehabilitated under this program contained span lengths of 15, 17 and 19 ft. In all cases the original untreated plank flooring and timber guardrail were worn out beyond any possible repair. But the four-pile bents, timber caps and most of the stringers—all treated timber—were in an excellent state of preservation. Thus the problem was simplified to one of removing the old flooring and guardrail, and adding new concrete roadway with timber guardposts carrying a beam-type metal handrail.

Last year a total of 1,820 lin.ft. of old timber bridges were re-decked with concrete, while a large project recently completed on State Route 99, near Thomaston, Ala., involved 13 bridges containing a total of 107 seventeen-foot spans.

At short bridges where stream conditions permitted, a detour over temporary pipe culvert was built to bypass traffic. But in most cases no detour was used yet by re-decking half the bridge (one lane) at a time traffic was virtually uninterrupted.

Although the original four-pile bents were strong enough to carry the added load of the 24-ft. concrete roadway, it was necessary to insert a 12x 12-in. false cap between pile cap and stringers, cantilevering it out on both sides to support double timber stringers carrying the roadway curbs. The original bridges had only 20-ft. roadways.

Jacking platform hung on piles

First operation was to go under the old bridge, snub a chain around each pile and insert a 6x14-in. timber—laid flat in the looped end of each chain to form a jacking platform.

Three hand-operated jacks then raised the old pile caps, freeing the ¾-in. drift pins holding caps to piles, and permitting pile-cutoffs to be made at correct elevation, with proper allowance for the added depth of false cap plus any desired grade change across the bridge. Ordinarily the cut-off of pile was about 10 in., with traffic passing over a 10-in. hump at each bent being remodeled until piles had been cut off, cap replaced and drift-pinned, and false cap inserted.

After all bents had been properly cut off and remodeled in this fashion the repair crew—one superintendent and eight convict laborers went on top of the bridge.

Holding up all traffic for about 10 min. they ripped off all flooring, felloe guard and handrail for one span, replacing it immediately with a temporary half-roadway width of floor plank salvaged from a previously repaired bridge. Temporary felloe guards were placed on the ends of this flooring, providing one traffic lane. Successively on each span, all old flooring was removed and replaced with one temporary lane, leaving the stringers exposed on the other half of the bridge.

Any exposed defective stringers were replaced with sound ones salvaged from bridge replacements on primary highways. Stringer spacing was reduced to carry the added load of concrete slab and H-15 live load, since the old bridges had been designed for H-10 loading. Stringer spacing was reduced from 18 in. to 16 in., c. to c. of the 6x14-in. stringers for the 17-ft. spans. Five stringers were added in each span to carry the increased loads, with double stringers being placed just inside of the curb lines.

Stringers were drift-pinned to the false caps which, in turn, were pinned and bolted to the pile caps. Three lines of 1x8-in. struts then were spiked flush tops with the stringers to hold them truly vertical while adding the half-width of concrete roadway.

Original plans contemplated use of 1x8-in. timber forms between string-

ers to support the concrete slab while it was being placed. But this method was abandoned in favor of a special wire-reinforced paper fabric stretched tightly over the stringers.

This fabric, known by the trade name of "Steeltex" floor lath, came in 180-lb. rolls, 4 ft. wide, each containing 500 sq.ft. It was purchased by the state at a cost of $5.50 to $5.90 per 100 sq.ft., delivered at the nearest shipping point. It is a single-ply 200-lb. kraft paper reinforced with an 8-lb.-per-1,000-ft. jute chord running longitudinally in the roll and spaced about ¼-in. apart. In addition, the paper is reinforced on one side with No. 12 electric welded galvanized wire fabric at 3x4-in. spacings. The paper was placed with the welded fabric down, in contact with the tops of stringers. The reinforcing fabric is fastened to the paper by special lacing wire.

WIRE-REINFORCED PAPER is used in lieu of lumber for forming concrete roadway. Widened roadway required additional stringer under each curb and false cap on existing timber bents.

Form paper tacked on stringers

Starting at the outer stringer, the end of a roll was securely tacked to stringer with 1½-in. staples at 6-in. spacing. A strip long enough to cover all exposed stringers in the half-roadway was stretched tightly across the stringers under about a 60-lb. tension, and tacked to each stringer top with 1½-in. staples at 6-in. spacing. The free end of the paper was inserted in a home-made "wire-puller" made of two 2x4-in. oak planks bolted together, and a 60-lb. tension was applied by two workmen with crowbars prying on the far edge of the last exposed stringer.

No timber framing was needed for the concrete slab, except for the outside face of slab and curb and a 10-in. width of curb-slab that cantilevers out over the outside stringer. The inside face of curb was formed with a standard steel curb-form held in place by discarded concrete guard posts, laid flat on the roadway slab.

Use of the wire-reinforced paper was a success. It not only replaced scarce timber framing, but its installation was rapid and simple, though care was necessary to avoid puncturing the material with a workman's heel, some pointed tool, or with the concrete vibrator when pouring the slab.

Other than placing the concrete deck in two half-widths, construction followed usual procedure. The roadway slabs are 24 ft. wide, 5 in. thick at curbs and 7½ in. at centerline to provide a 1½-in. roadway crown. They are reinforced transversely with ⅝-in. bars, top and bottom, and bent up into the 11-in. high by 8-in. wide curbs. A closed construction joint was made on center line of roadway, so that when the first half of roadway was poured, it was necessary to bend the exposed half-length of transverse bars back along the center line to clear the temporary timber roadway.

Timber runways were built out over the slab being poured, to support wheelbarrows used for transporting the concrete. Supports for the runways were placed directly over roadway stringers.

Finish of concrete was by wooden screed operating on job-made screed supports anchored directly over pile caps. These screeds were made of 1-in. steel pipe bent to a 1½-in. crown for their 12-ft. lengths. Two nuts were welded beneath the pipe at each end, with short lengths of ¾-in. rods forming the vertical legs of the screed support. These rods were threaded in the nuts to permit vertical adjustment of the height of the screed support. They were held vertical by wire wrapped around the pipe and spiked to the tops of stringers.

Handrails on the newly-decked rehabilitated bridges are single lines of corrugated structural beam, mounted at the top of 3-ft. timber posts, 1 ft. 9 in. above top of curbs and anchored with two ¾-in. bolts embedded in slab and curb. Posts are spaced 6 ft. 3 in. apart.

The guard rail was bought new, in 12½-ft. lengths with end holes shop-punched. Holes for bolting rail to intermediate posts were burned in the rail after it was tacked to the posts at proper elevation. Matching holes then were drilled in the 6x6-in. timber guard posts with a power drill driven by a small portable electric generating set.

With the exception of the reinforcing steel and concrete aggregates, the only new materials bought were the fire-fabric reinforced paper for forming the slab, the guard rail, interior curb form, and incidental bolts, drift pins, nails and tying wire. Guard rail posts were salvaged material as well as the small amount of lumber needed to form the outer face of curbs.

These and other economies enabled the state maintenance crews on this work to redeck the old timber bridges with reinforced concrete at an average cost of $38 per lin. ft. of bridge. In comparison, the cost of building complete a 24-ft. roadway concrete-decked timber bridge using all new materials under a recently awarded contract ran $83 per lin. ft. of bridge.

H. G. Beaird was resident engineer on the 13 bridges rehabilitated near Thomaston, Ala., under Herman Orr, division engineer. The work was under the direct supervision of J. W. Smith and Leo Fuller, maintenance superintendents. Similar redecking of timber bridges is being done in Division 3 under S. J. Cumming, division engineer, and in Division 7 under T. H. Espy. The entire program is under the supervision of Geo. W. Phillips, chief engineer, Bureau of Maintenance, reporting to Ward W. McFarland, director of the Alabama State Highway Department.

Hotel Faced With Plastic and Aluminum

DEMONSTRATING their acceptance of new materials and methods that cut the cost of building, Canadian builders have now completed the striking 21-story Laurentien Hotel in Montreal. Features of this structure include extruded aluminum exterior facing, interior and exterior facings of plastic, prefabricated bathrooms, precast lightweight concrete floors and dry-wall partitions between rooms.

Located at the Windsor-Dorchester intersection in central Montreal, the 190x245-ft. edifice rises 240 ft. above the sidewalk. Of two floors below ground level, one serves as a 150-car garage.

For the structural frame, 3,500 tons of steel were used, detailed to keep the vertical dimension of the floor system to a minimum. Beam-to-column connections were designed to take wind stresses (Fig. 11), because the dry-wall partitions and cinder-concrete block exterior walls can carry little shear due to wind loads.

Concrete floor slabs were kept to a maximum thickness of 6 in. (Fig. 10) to maintain a spacing between bedroom floors of 9 ft. 3 in. Precast channel-shaped slabs designed for a 40-psf. live load and set between 4-in. H-beams form the bedroom floors. Made light-weight by expanding the concrete through addition of aluminum powder to the mix, these slabs are generally 1 ft. wide and up to 8 ft. long, with a 1½-in. thick top slab and 4-in. flanges. Both sides of these slabs were sealed with cement plaster to keep out moisture.

FIG. 1. THE LAURENTIEN HOTEL in central Montreal is faced with plastic, aluminum and limestone.

Floors in the public halls, offices and baggage areas consist of precast concrete slabs made with a lightweight aggregate and capable of taking a live load of 100 and 125 psf. Ceilings and beams are faced with vermiculite plaster, steel-trowelled and broomed to a travertine finish before painting.

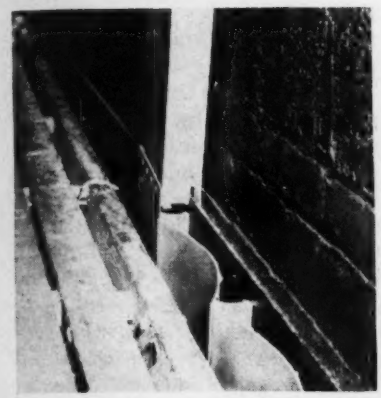
Board with insulation forms walls

Interior partitions are of the dry-wall type, consisting of a rolled steel frame on both sides of which are ½-in. thick plasterboard, fastened with self-tapping steel screws. Between the facings is ½ in. of glass fiber insulation. On the outside, a pebble-grain-texture cotton fabric, surfaced with a linseed linoleum and having the appearance of oilcloth, was fastened to the sized surface with casein glue. Walls in public rooms are covered with standard hard-wall plaster.

There are 50,000 sq.ft. of partition per floor. A crew of 12 to 15 men erected all partition framing on one floor in one week, and a crew of 30 to 32 men placed insulation and plasterboard, filled joints and painted a floor a week.

The exterior of the building consists of a 12-in. thick cinder concrete back-up wall with outside facing of several different types of material (Fig. 1). Indiana limestone or extruded aluminum was applied to the vertical strips between windows. Spandrels consist of a ¾-in. thick plastic board, cream-colored adjacent to the limestone facing and dark green contiguous to the aluminum. They were fastened to the concrete block with case-hardened nails, which were later covered by the edge of the aluminum facing.

This plastic is a paper-base laminate bonded with lignin and surfaced with a synthetic melamine resin. Kraft paper for the laminations was made by standard practice, except that non-water-soluble lignin powder was added to the stock in the beaters and thus was incorporated in the finished product. To form the board, several sheets of the paper plus the plastic surface sheet was subjected to



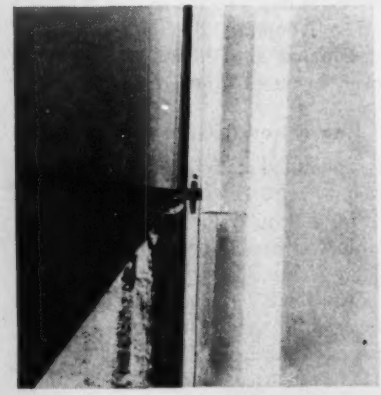


FIG. 2 TO 5. EXTRUDED aluminum sections were attached to steel T-bars anchored in the backup wall

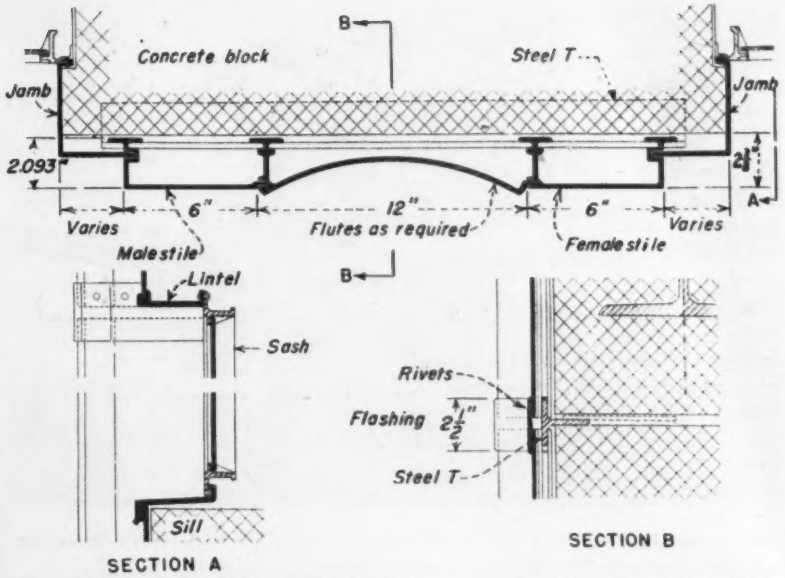


FIG. 6. A HORIZONTAL SECTION indicates the three major types of extrusions used as facing. Special extruded lintels hold spandrels in place.

high pressure (1,000 psi.) in a press at a temperature in excess of 300 deg. F. to fuse the lignin binder.

The board was made with a residual stress that makes it slightly concave toward the finished surface. This results in its being slightly weaker in resistance to bending stress caused by blows from the concave side and necessitates careful handling on the job. However, the curvature has the advantage of eliminating air pockets behind the board when the edges are pulled down by the retaining molding or other means of edge fixation.

Practically impervious to water, the plastic was also used for several other purposes throughout the hotel. Sheets ⅛-in. thick, attached to plywood with casein glue, serve as table tops and window stools. These sheets contain an aluminum foil under the surfacing to dissipate heat. For the main lobby walls, the plastic was fastened to plywood by aluminum molding and chrome-plated brass screws. About 250,000 sq.ft. of the plastic was utilized in these various ways.

Large area faced with aluminum

Some 180,000 lb. of extruded aluminum was used to face about 70,000 sq.ft. of the exterior pilasters of the hotel, with an estimated saving of 50 c. per sq.ft. over an alternative of Indiana limestone. Vertically fluted the facing extends from the third floor to the roof, where it is capped with limestone. Holes are provided at the base against the possibility that condensation may collect behind the facing.

The metal is Aluminum Company of Canada, Ltd., alloy 50S (equivalent to Aluminum Company of America 63S), temper A33, air-quenched at the die followed by an aging treatment. Finishing consisted of hand-wiping to remove excessive dirt or grease, vapor degreasing and rinsing in cold water for the purpose of checking the "water break." Thereafter the material was put through a standard 30-min. anodizing procedure, followed by a 30-min. seal in boiling water.

Notched legs anchor extrusions

The facing consists essentially of fluted, stile and jamb sections (Fig. 6). However, at the vertical junction between the aluminum and limestone facings, a type of extrusion not shown in Fig. 6 was used. It is a flat-faced section with a shallow rear leg on one side (Fig. 4).

The legs of the fluted and jamb sections consist of a flange and a web with a heavy double bead—the legs being notched to slip over the flange of a horizontal steel T-bar, the web of which was embedded in the masonry (Fig. 2 and 3). Notching was done on the site by using a power hacksaw to remove a short length between the flange and the

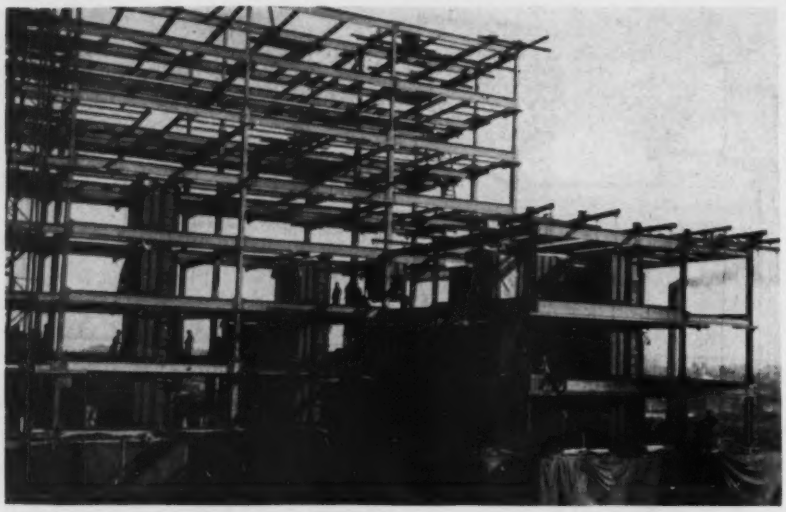


FIG. 7. FACTORY-BUILT BATHROOMS were installed back to back on the structural frame of the hotel as completed units.

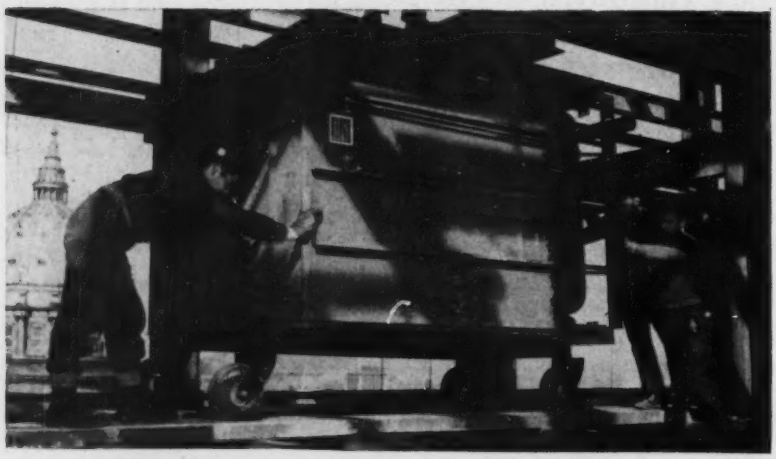


FIG. 8. BROUGHT into the building before masonry walls or floors were placed, prefabricated bathrooms were wheeled into position over wood planks.

FIG. 9. BATHROOMS were bolted to the building steel. Bedroom floors were brought to bathroom level when concrete slabs and carpet finish were placed.

bead at both ends of every leg. The bead served as a back-up bar, or stiffener to facilitate the notching and anchorage to the T-bar. In the case of the stiles—the flat-faced sections between the flutes and the jambs—the bead was replaced by a deep channel that receives the jamb section (Fig. 6).

The junction at the T-bar permits expansion and contraction, and is covered by a flashing of 2S-½H sheet, $\frac{1}{16}$ in. thick (Fig. 5 and 6). These flashings were preformed, anodized and riveted on the extrusions with 2S rivets. On bevels where riveting was not possible, self-tapping cadmium-plated steel screws were used.

The T-bars are 2x2 in. Fastened to the masonry by welded fish-tail anchors spaced 2 ft. on centers, they were set 9 ft. 3 in. apart, in line with the window heads (Fig. 2), with an accuracy of ¼ in. Since the extrusions were ordered 9 ft. 3 in. long, the facing had to be cut at the site. The exact length of extrusion to fit between the T-bars, with adequate allowance for expansion upward, was gaged for each panel in every story, and the excess trimmed off. Adoption of this procedure eliminated any difficulty due to uneven spacing of the T-bars.

Five extruded types form panels

The fluted sections of the facing are about ⅛ in. thick and 12 in. wide (Fig. 3)—near the limit of the possible width obtainable by extrusion. They weigh 2.83 lb. per lin. ft.

The jamb sections (Fig. 5) have a face width that varies from panel to panel. Hence, two widths of jamb extrusions were supplied, and these were ripped on a band saw, as required, to suit variations in face-width dimensions and to fit closely around sills and spandrels. Angle-shaped, the jambs were secured to the building by self-tapping screws through the previously fixed steel sash and also by their tongue connection with the stiles.

There are two types of stiles on this job—single-legged males, and double-legged females (Fig. 6). Common practice in erection was to start with the double-legged stiles on one side of each panel. Then the fluted sections were canted into position, pivoting about the bottom T-bar. To allow the notched legs to slip into place,

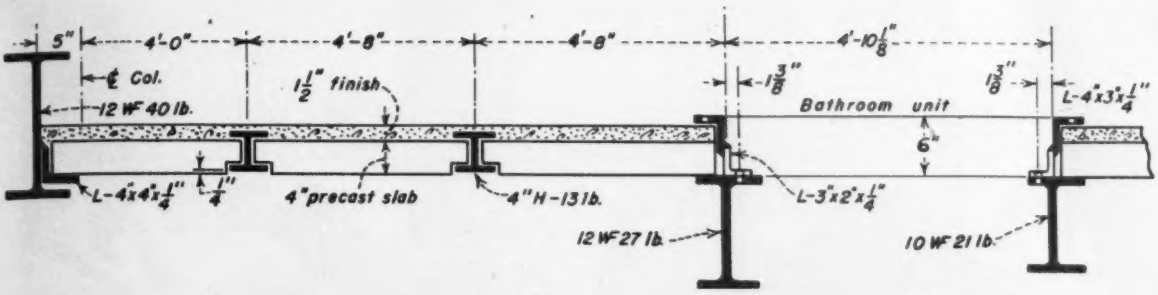


FIG. 10. SECTION through part of a bedroom floor, indicating opening for prefabricated bathroom unit.

a clearance of $\frac{3}{8}$ in. was provided between the flange of the bar and the masonry. The panel was completed with placing of the single-legged stile and jamb sections.

For protection against electrolytic action, the faying surfaces of the flashing were coated with a brush grade of an asphalt mastic containing aluminum flakes. A gun grade of this mastic was used for bedding the tongue and groove joints of the facade, and a liberal coat of bituminous paint was applied to the concrete block walls and the steel T-bars.

Aluminum was also used in the building for exterior window sills, lintels, main entrance canopy, store front, moldings, convector castings, mezzanine railings and kalamein doors. The extruded sills were of standard type, while two sizes of special lintels were designed to receive the plastic spandrel (Fig. 6).

Prefab bathrooms speed erection

Another outstanding feature of this hotel is the 1,100 bathroom units that were factory built and shipped to the job without crating. Weighing about 1,500 lb., the welded, steel-framed units arrived at the site with interiors complete in all respects. They were placed back to back (Fig. 7), and sewer, water, ventilation and electrical connections were made from the outside. A crew of 15 men placed and bolted 45 units per day to the structural steel frame of the building (Fig. 9 and 10), and a crew of 30 plumbers was employed for five months to complete all plumbing.

Units used are 6 ft. $6\frac{1}{2}$ in. long by about 5 ft. wide. Each contains standard fixtures—enameled pressed steel tub with shower, lavatory, water closet, door, towel rack, shelving, mirror and light. The interior walls and ceilings were formed of the same plastic board used for the spandrels, but fastened with aluminum molding and stainless steel screws. Glass-fiber insulation and plasterboard were affixed to the exterior by the partition crews. The floor is composed of 10-ga. steel plate covered with linoleum casein-glued in place.

While the contractor highly praised the bathrooms for ease of installation, it is to be noted that there was considerable breakage of the plastic caused by striking the reverse side of the board with construction materials, and some buckling of the floors under load is noticeable. The cost of the bath units f.o.b. the job averaged $632 each and installation is about $150 each, additional.

Design of the hotel was by the owner, the Laurentien Hotel Co., Ltd., and A. L. Amos, P. C. Amos and C. Davis Goodman, associate architects, of Montreal. G. McL. Pitts was consulting architect and engineer. General contractor was Wilson Contracting Co., Ltd., for whom John Wilson is president and project manager, Frank Strachan superintendent, and James A. Laughton and J. A. Grant staff engineers.

Structural steel was designed, fabricated and erected by the Dominion Bridge Co., Ltd. The prefabricated bathroom units were manufactured by the St. Catharines Steel Products, Ltd., and installed by the general contractor, who also placed the aluminum facing and the plastic spandrels.

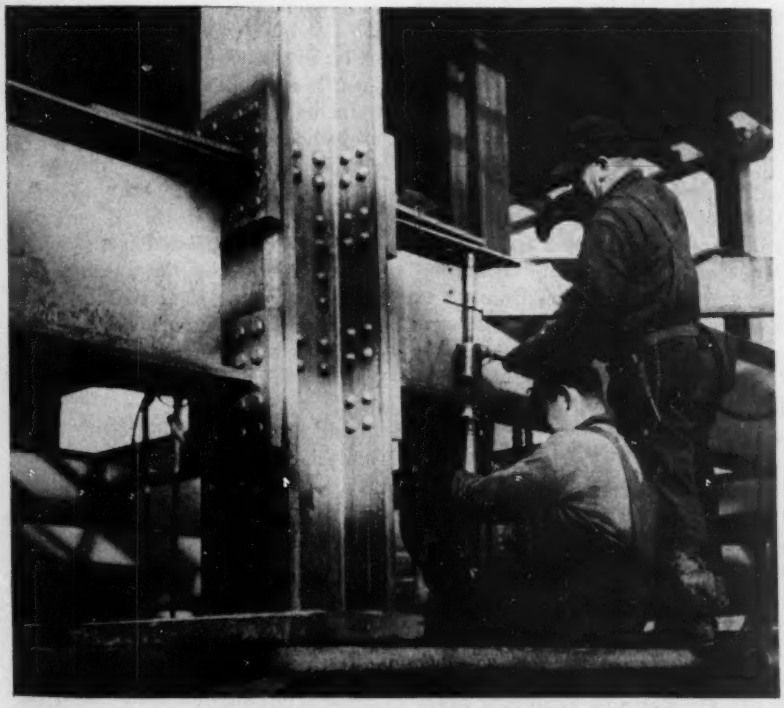


FIG. 11. BEAM-TO-COLUMN connections were designed to take wind stresses.

Fig. 1. This machine, improved on this job, is weighted down with sand bags to obtain a well-compacted asphaltic lining.

Test-Linings Placed in Small Canals

CONCRETE, asphaltic concrete, gunite and asphaltic prime membrane were used in lining small irrigation canals and laterals on the Pasco lateral system of the Columbia Basin project to encourage development of inexpensive placing equipment and linings. A comparison of these linings, both as to first cost and upkeep, will result. However, the immediate major contribution of the job was improvement in the equipment for placing asphaltic-concrete linings.

The Bureau of Reclamation seeks to encourage development by contractors and materials men of efficient machinery which could produce effective low-cost canal linings. Most of this work, in the past, has been on relatively large canals and the overall program was described in *ENR* Feb. 6, 1947, vol. p. 192. The Pasco work is intended to provide experience on small canals to guide later work in the Columbia Basin and elsewhere. Canal sizes at Pasco vary from one with a 5-ft. bottom width having a capacity of 119 sec.-ft. to one with a 2-ft. bottom width with a capacity of 3 sec.-ft.

The Pasco lateral system, located some 12 miles northwest of Pasco, Wash., will permit delivery of the first water to be used for irrigation in the bureau's Columbia Basin irrigation project. It consists of some 23 miles of canals and laterals which will serve 5,361 acres of project land. This area is divided into 80 family-size farm units, varying from 40 to 120 acres of irrigable land and averaging about 70 acres. Most of this land is privately owned but at present is entirely undeveloped.

Special pumping plant

This system is located at the extreme southern end of the irrigation project and it will be a number of years before water pumped from Grand Coulee Dam will be available to this area (*ENR* May 16, 1946, vol. p. 780). However, to get this area under cultivation at an early date and to provide means of comparing canal linings, a special pump plant is being built to deliver water directly from the Columbia River and this system of laterals will serve to deliver it to farm land.

Included in the Pasco work were asphaltic-concrete linings 2 in. thick, portland-cement concrete linings 2 and 3 in. thick and gunite linings 1½ and 2 in. thick. Based on unit bid prices and the estimated cost of materials furnished by the government, the approximate total unit cost for the asphaltic concrete linings was $2.47 per sq. yd. without soil sterilants and $2.83 per sq. yd. with sterilants.

This can be compared with costs similarly computed for other materials as follows: 1¼-in. gunite—$2.33, 2-in. gunite—$2.67, 2-in. concrete—$2.39, and 3-in. concrete—$2.71. Relatively high cost of the asphaltic-concrete construction may be attributed to high bid prices due to lack of experience and insufficient cost data on this type of canal lining.

Actual installation costs based on records kept during the work to com-

pare cost of the various types of linings indicate that the 3-in. portland-cement concrete was most expensive. Cost of other linings as compared with and expressed in percentage of the 3-in. portland-cement concrete lining are somewhat as follows: 1½-in. gunite—75 percent, 2-in. gunite—80 percent, 2-in. concrete—75 percent, and asphaltic-concrete—50 percent.

The Pasco work involved considerable experimentation with placing equipment and, according to bureau engineers, a basic cost of even less than 50 percent of the cost of the 3-in. cement concrete lining might have been achieved for asphaltic-concrete construction if the most advantageous methods of construction had been used throughout the operation.

Paver undergoes transition

To encourage development of a machine for placing asphaltic-concrete linings in small canals, the specifications provided that "paving machines . . . be capable of placing the entire width of lateral lining on one operation . . ." Accordingly, the contractor used a paver developed for some California work, but which had not had a thorough on-the-job test. This paver underwent several changes and, according to bureau engineers, in its final version it produced a good canal lining. However, additional changes are felt advisable to better suit the paver for canal-lining work.

In its final state, the paver included a pan some 8 ft. long shaped to fit the bottom of the canal section. This pan carried the winch and motor used to propel the mechanism. Stabilizers, shaped to fit the berm of the canals, were attached to supporting arms at the rear edge of the pan to help maintain alignment and prevent rocking. Beams extending to the rear of the pan connect with the strike-off beam and ironing screed.

Hot asphaltic-concrete mix is placed in the paver behind the pan and the machine is slowly drawn forward. A strike-off beam, consisting of a built-up box-beam 6 in. wide, spreads the material. This is followed by a butane-fired hot screed some 11 in. wide shaped to fit the canal section. Plates welded under the strike-off beam starting at the leading edge and extending to the hot screed make, in effect, a screed some 20 in. wide, the latter 11 in. of which is hot. Sand bags totaling some 3,500 lb. are loaded on the screed to weigh it down.

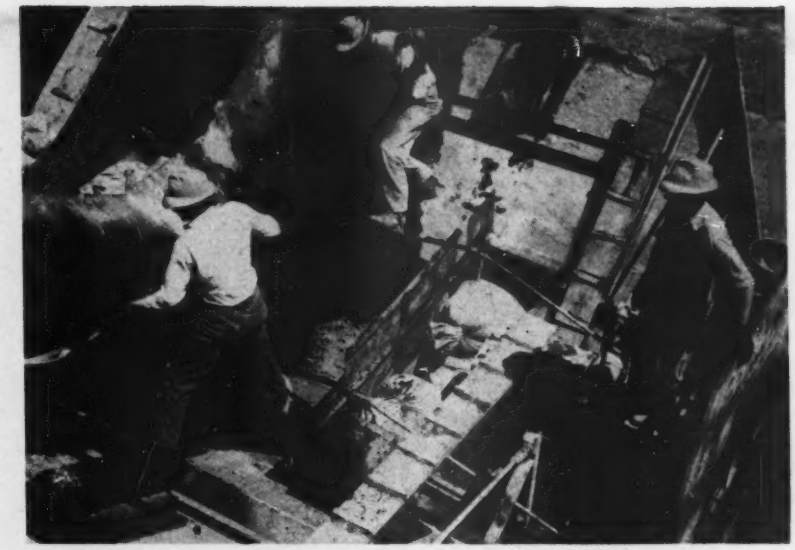


Fig. 2. Workmen spread the asphaltic concrete mix while waiting for a fresh charge. When a continuous hot-mix supply is available; a clamshall bucket suspended from a crane effectively spreads the material. Stabilizers in lower left and upper center help prevent rocking of machine in canal.

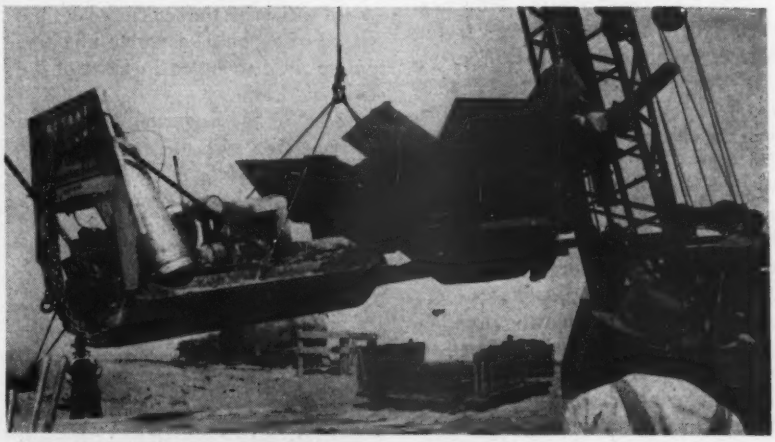


Fig. 3. Smooth bottom of pan and screed can be seen as paver is moved by a crane. Cylinder near motor carries butane to fire screed.

The hot screed has a variable pitch permitting adjustment. The strike-off beam has a fixed pitch of ¼ in. but can be rotated slightly if necessary.

By means of a cable attached to a dead-man, the winch mounted on the pan pulls the machine along the canal. Rates of progress vary from 3 to 5½ ft. per min. As placing the dead-men in the canal subgrade is expensive and detrimental to the canal lining, a tractor was used throughout most of the work for this purpose.

The effect of this arrangement is that the stabilizers control the alignment, the pitch of the screed controls the thickness, and the static load of the sand bags controls the degree of compaction. The pan, originally intended to perform these functions, merely acts as a support for the winch and its motor. Bureau engineers feel that the mechanism could be improved by eliminating or shortening the pan. Friction developed between it and the subgrade is so great that several winches were worn out during the work and a large-capacity winch with special oil cooling was finally used.

Converting the paver from one size of canal to another was a delay-

ing feature of the work. On the asphaltic-concrete paving work, there were two depths for each of three canal-bottom widths, namely, 5-, 4-, and 3-ft. bottom widths, and three depths with a 2-ft. bottom width. To convert from one depth to another each having the same bottom width, it was necessary to take out or insert sections on each side slope of the strike-off beam and hot screed.

To convert to a canal size having a different bottom width, it was planned to use a different pan in addition to changing the size of the strike-off beam and screed. The original paver had a pan for a canal 5 ft. wide. New pans were not available for the 4-ft. and 3-ft. canals, so a section was cut from the middle of each pan.

Work was so scheduled that the change from 5 to 4 ft. bottom width came at the end of a shift. Mechanics working during the night accomplished the conversion with no loss in regular working hours. However, other changes interfered to varying degrees in the regular work progress.

Moving the paver from one location to another and over structures, such as checks and Parshall flumes, also was a time-consuming process. In such instances, a crane was attached to the paver to lift it over the structures. Where the distance was great, the paver was loaded on a truck. It was felt that much thought could be devoted to minimizing the number and length of such moves. In particular, bureau engineers are reviewing the design of canal turnouts and checks to permit easy passing of paving machines.

Original paver changed

The machine first used on this placing work had, following the screed, a 24-in. dia. roller for the invert and two 12-in. dia. rollers, one for each side slope. The side slope rollers were abandoned early in the work. The bottom roller was later abandoned as it did not appreciably improve the compaction of the asphaltic-concrete and roller checks were produced in the lining surface.

The screed on the original paver was built in three sections which required hand finishing with hot rollers at the corners between the invert and the side slopes. This was remedied by making the screed continuous with rounded corners.

Fig. 4. Gunite was used on some of the smaller canals. Bureau specifications call for trowelling rebound into the canal, but this was waived on some Pasco work.

The stabilizers were also an afterthought. Without them, the machine would twist in the canal when the charge of asphaltic-concrete mix was not evenly distributed in front of the strike-off beam.

A further improvement was made in connection with the application of a seal coat. Specifications for this job provided that where necessary, a seal coat of hot asphalt be placed over the machine-placed asphaltic-concrete to assure imperviousness of the lining. This seal coat had to be smoothed by means of hot irons having a temperature of not less than 250 deg. F. However, when sand bags were used to weight down the screed, it was found that the additional loading tended to force asphaltic cement to the surface of the relatively rich mix, thus making it unnecessary to apply the seal coat except in a few places. Of a total of 88,160 sq. yd. of asphaltic-concrete paving, only 6,347 sq. yd. required a seal coat. For the most part, this seal was required only in hand-placed sections of lining adjacent to structures.

Gunite lining placed swiftly

To afford a comparison with the asphaltic-concrete lining, gunite lining with thicknesses of 1½ in. and 2 in. was used on some canals. No reinforcing was required and it was found that, where a good subgrade had been prepared, the gunite lining went on with little or no difficulty. Although the specifications required that rebound be troweled into the lining, bureau officials believed that the little rebound that actually occurred would have a minor effect on the flow of water in the canal and this requirement was removed on most of the Pasco work. An advantage of the gunite work was that the equipment was compact and could easily be moved from one location to another.

Transverse contraction joints, ⅜ in. deep and ¼ in. wide, were placed in both the gunite and the portland-cement concrete linings at 6-, 9-, and 12-ft. centers. These joints were filled with a special mastic joint filler developed by the bureau and placed cold, while the concrete was still green, by a type of grease gun. This filler is composed of dry ingredients consisting of powdered asphalt, diatomaceous earth, and powdered limestone and wet ingredients consisting of an asphaltic flux oil and a plasti-

TABLE I—LININGS-PASCO LATERALS

Type	Thickness in.	Length mi.	Surface Area sq.yd.
Concrete	3	1.86	23,397
Concrete	2	1.19	15,744
Gunite	1½	2.89	17,109
Gunite	2	0.61	8,006
Asphaltic Concrete	2	11.17	88,160
Prime Membrane.....		0.18	1,551
Concrete Pipe*.....		5.0	.....
Unlined Ditches.....		4.5	.....
Total		27.4	156,966

*12 to 42 in. dia.

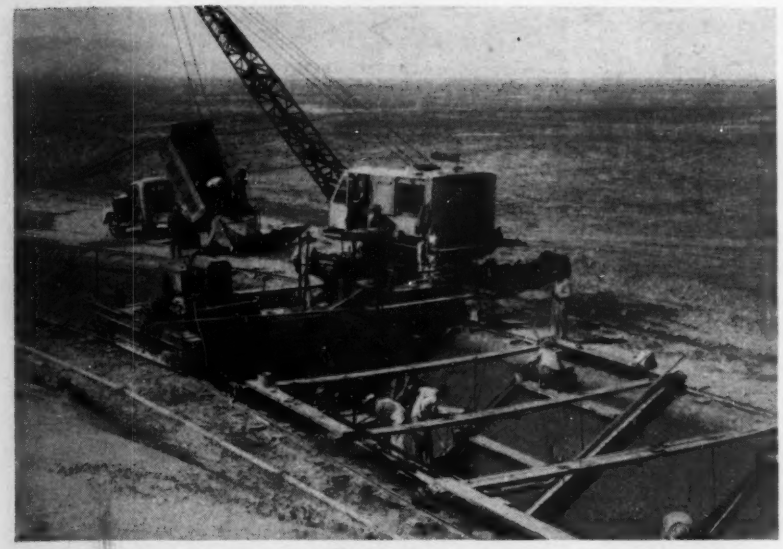


Fig. 5. Concrete lining was placed by means of a train of rail-mounted equipment of the type now familiar on many Western canal jobs.

cizer. The dry and wet ingredients are mixed on the job just prior to placing in the joints.

The mechanism used to place portland-cement concrete lining is similar to that used on many Western canal jobs, large and small. A series of rigs mounted on rails are used to place concrete, support finishers, place joints, and spray curing compound. No major developments were forthcoming from this work, since concrete has been in use for this purpose for many years. This method was employed to serve as a comparison to the other types of lining.

Prime membrane lining

The Bureau of Reclamation has made previous installations of prime membrane lining (basically asphaltic cement sprayed on bare subgrade), particularly in the Roza project. However, because the subgrade on the Pasco project could be easily well compacted, a situation not obtained on previous work, a section of 0.18 mile of canal was lined in this manner.

TABLE II—ASPHALTIC-CONCRETE MIX

Aggregates:

Screen Size in. or mesh	Specified Percent Passing	Actual* Percent Passing
¾	100	100
½	80-100	99.5
4	65-90	74.2
10	55-80	65.5
40	15-35	35.3
200	5-12	9.8

Asphalt: 8 to 8½ percent by weight. Mostly 60-70 penetration, some 50-60 penetration

* Average of 71 field tests

To prepare the excavated and compacted canal for a prime membrane lining, a pre-prime coat of diesel oil is sprayed on cold at the rate of 0.75 gal. per sq. yd. On a small portion of the area sodium chlorate soil sterilent was used instead of diesel oil. Next, a prime coat of RC-O asphalt cement heated to 400 deg. F. in a 600-gal. distributor was sprayed at the rate of 0.5 gal. per sq. yd. by a hand snivey. Finally, a seal coat consisting of a mixture of diatomaceous earth and 60-70 penetration asphalt cement heated to 400 deg. F. in the distributor and sprayed at the rate of 0.6 gal. per sq. yd.

Mixing of the preheated asphalt cement with the diatomaceous earth was accomplished in a 4-cu. ft. tilting concrete mixer which dumped directly through a V-shaped wooden trough into a distributor. The proportion was 23 lb. of diatomaceous earth to 83 lb. of asphaltic cement. Results of the installation of this type of lining appeared to be good but as yet are not conclusive. Cost figures are not available for prime membrane lining.

Structures used on this system include bridges, checks, vents, standpipes, spillways, chutes, division boxes, drainage culverts, drops, check drops, drain inlets, Parshall flumes, wasteways and weirs. A good percentage of the cost of the work went for the building of these structures. Almost all of the ones frequently used, such as Parshall flumes, required considerable formwork and special structural-type concrete. Some structures were standardized to allow forms to be reused.

Pumping plant supplies water

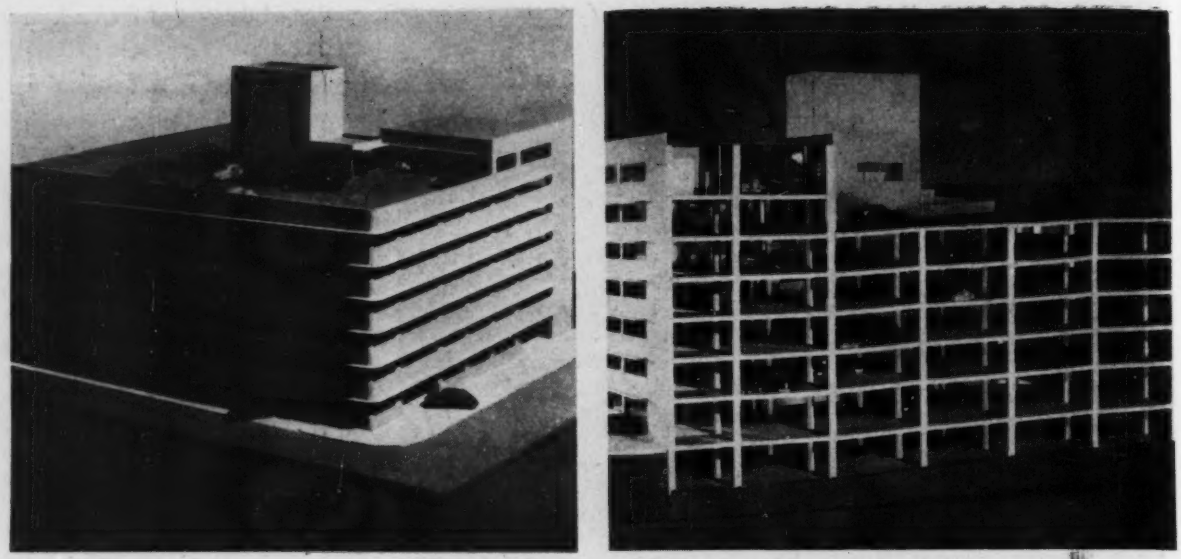
A pumping plant, yet to be completed, is being built to supply water for the lateral system until such time as water pumped from the reservoir behind Grand Coulee Dam reaches the project. This plant has two pumps, which lift 126 cfs. of water a vertical distance of 167 ft. through a 5-ft. dia. steel pipe.

As is the case in much construction work these days, completion of the pumping plant had been delayed for lack of some mechanical equipment. However, the plant was expected to be finished in time for the 1948 irrigation season. The work schedule called for completion of tests on the plant by March 1, 1948.

Seven relift pumps are being installed along the lateral system to lift water to higher elevations. The final lateral system work involved the construction of the relift pump plants. Some 13.5 miles of 13.8-kv. electric transmission lines are also under construction.

Work on the Pasco lateral system is part of the Bureau of Reclamation's Columbia Basin irrigation project. Walker R. Young was chief engineer of the bureau and Frank A. Banks is in general charge of the Columbia Basin project. C. W. Seeholzer, resident engineer on the work, reported to H. A. Taylor, construction engineer, and H. A. Parker, in charge, irrigation division, Columbia Basin project.

Contract for the lateral system amounted to $714,223 and was held by J. A. Terteling & Sons, Boise, Idaho, for whom Al Perry was superintendent. James Construction Co., Seattle, Wash., is building the pumping plant under a $188,537 contract and James Pearce is superintendent of construction. Pumps are being manufactured by Worthington Pump & Machinery Corp. of Harrison, N. J. The Ekenstam Canal Paver, manufactured by the Madsen Iron Works, Huntington Park, Calif., was used for asphaltic-concrete lining work.



PARKING SPACE and access ramps are combined in the spiral floor of a six-story Los Angeles garage.

Spiral Garage Permits High Space Use

A SIX-STORY and basement parking garage under construction in downtown Los Angeles, Calif., has a floor that is continuous from story to story. The design eliminates ramps and freight elevators as a means of reaching upper areas and permits 500 cars to be accommodated on a 145x152-ft. lot.

The continuous floor or spiral is estimated to save some 30 percent in construction cost per parking space as compared with a level-floor-and-ramp design. Maximum space utilization, convenience and economy are achieved by means of floors having a slope of only 4 percent.

The building is the equivalent of six stories in height, and parking space will also be available in the basement.

The garage is being built for the General Petroleum Corp. in connection with the construction of a large office building located nearby. It will satisfy provisions of a Los Angeles city ordinance that require one parking space per 1,000 sq. ft. of new office space, located in the new building or within 1,500 ft. of it.

General Petroleum officials decided it would be more economical to provide a separate garage building, but the only available space was too small for a garage of conventional layout. The spiral design provide a solution at a relatively reasonable cost.

The problem of ventilation, usually costly in enclosed garages because of carbon monoxide, is met by omitting glazed windows on the two street sides, except at street level, taking advantage of the mild climate of the area. Normal mean temperature in January in Los Angeles is 55 deg. as compared with 31 deg. F. for New York or 13 deg. F. for Minneapolis. In colder climates, of course, some ventilating system would have to be added. This probably could be done by taking a little extra room in the central core of the building.

The continuous floor is about 60 ft. wide, to provide a two-way traffic lane 20 ft. wide in the center, and a 20-ft. space, at either side for parking. Columns are spaced to give additional width for the traffic lane at turns. The spiral is built around a central utility core that includes, among other things, passenger elevators for car owners.

Drivers park their own cars

This design is believed to be adaptable to either attendant or self-parking systems. It is currently planned to assign stalls in the building to specific cars belonging to the company, its employees, or tenants of the new office building. Drivers will then park their own machines.

There are four exits, and it is estimated that the entire 500-car garage can be emptied in half an hour under peak traffic conditions. Service facilities, such as washing and lubricating, are located on the roof to eliminate ground floor confusion.

Resistant to seismic forces

The continuous open spaces for ventilation are 4 ft. 6 in. high, leaving a solid 6-ft. band between. Such a deep spandrel, reinforced to take some of the lateral loads imposed under possible earthquake conditions, works well into the general scheme for resisting seismic forces. The rest of the lateral loads are taken by nearly solid walls on the two sides away from the street and a solid shear wall in the central core.

Since the roof will be used for parking as well as servicing and washing, two gutters will intercept runoff from rainfall. These are placed transversely to the traffic flow at the opening to the roof area and about 20 ft. farther down. The first opening will catch most of the runoff, but any excess or drip from cars will be caught by the second gutter.

Walter Wurdeman and Welton Becket were architects; structural design was by Murray Erick Associates of Los Angeles, and P. J. Walker Co. is general contractor.

FIELD AND OFFICE

PILE LEAD LENGTHENER

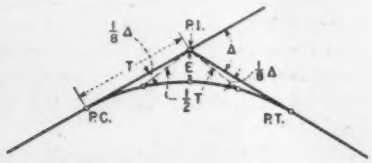
When a few extra-length H-piles exceeded the capacity of available pile driver leads Western Concrete Pile Co. devised a simple means of starting the piles.

The heavily-built casing shown is driven with its sloped bottom flaps closed. The long piles are dropped into the casing, permitting use of greater length than the hammer could be set on to drive.

Flaps at the bottom of the casing are forced open by the pile. After the pile is driven, the casing is withdrawn for reuse. The same casing can be used to penetrate near-surface obstructions that might damage the pile.

Locating Points of a Curve from Point of Intersection

With a transit set up at the P. I., quarter points on a curve can be established quickly as shown in the accompanying sketch.



For rough grading and spur tracks, quarter-points on curves are located from the point of intersection.

Steps in laying out three equidistant points on the curve are:

1. The first and third quarter points are located by turning off an angle from each tangent equal to one-eighth of the angle of intersection and measuring one-half of the tangent distance along this line.

2. The mid-point of the curve is placed by bisecting the internal angle and laying off the external distance.

This method is useful in fitting a curve to the ground and locating a curve for rough grading or spur tracks.—GERALD R. HYDE, *Nashua, New Hampshire.*

Jeep-Mounted Scoop Digs and Cleans Ditches

To clean old ditches and "rough out" new ones, the Toledo Area Sanitary District uses a small metal scoop mounted behind a Jeep. The 24-in. wide, 200-lb. scoop, which has a capacity of 6 cu. ft., is suspended from the Jeep at three points and is operated by a hydraulic linkage system. It can be attached or detached quickly permitting use of the vehicle for other work while on the job.

The scoop is raised or lowered by operating a lever at the driver's seat. It is dumped by a pull-rope.

The scoop-equipped Jeep is particularly useful in "roughing out" both large and small ditches. In one operation, spoil may be moved from a ditch and spread in fill. The equipment is limited to work on dry sites.

The hydraulic lift and scoop cost $250, of which $25 was for installation.—HERBERT A. CRANDELL, *Superintendent, Toledo Area Sanitary District, Toledo, O.*

Equipped with a hydraulically operated scoop, a jeep is used by the Toledo Area Sanitary District, Toledo, O., to dig and clean drainage ditches.

READER COMMENT

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L. C. BISHOP
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Cheyenne, Wyoming

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Pittsburgh, Pa.

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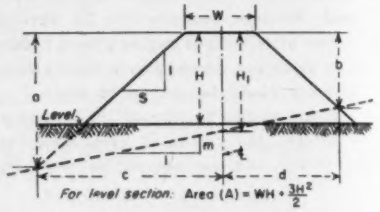

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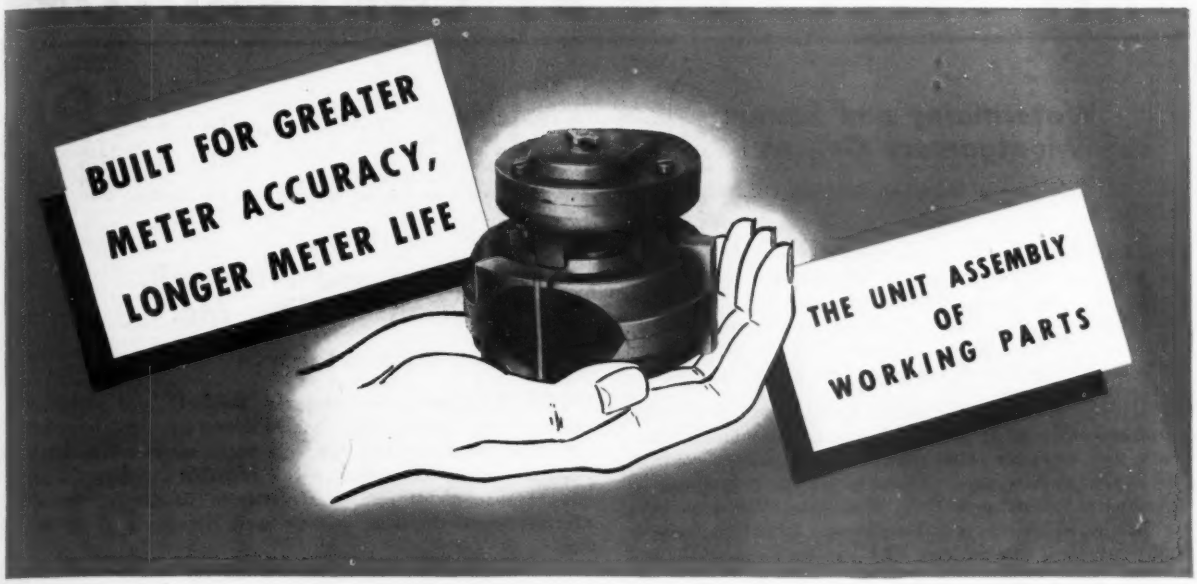

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PITTSBURGH DISC WATER METERS

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ARCTIC FROST PROTECTED TYPE
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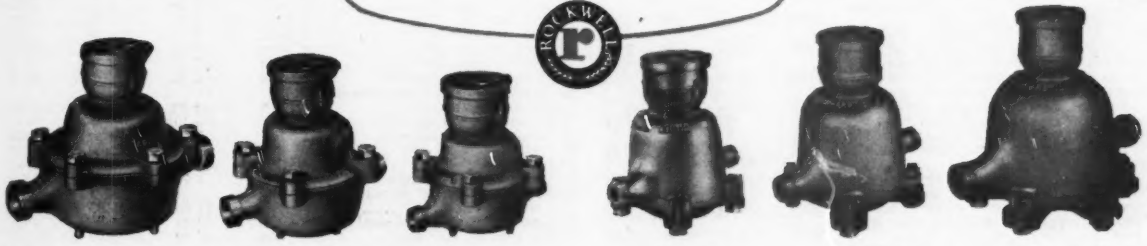

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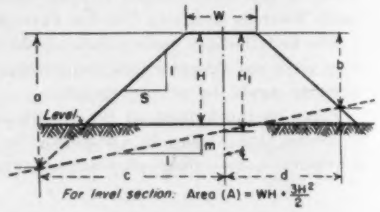

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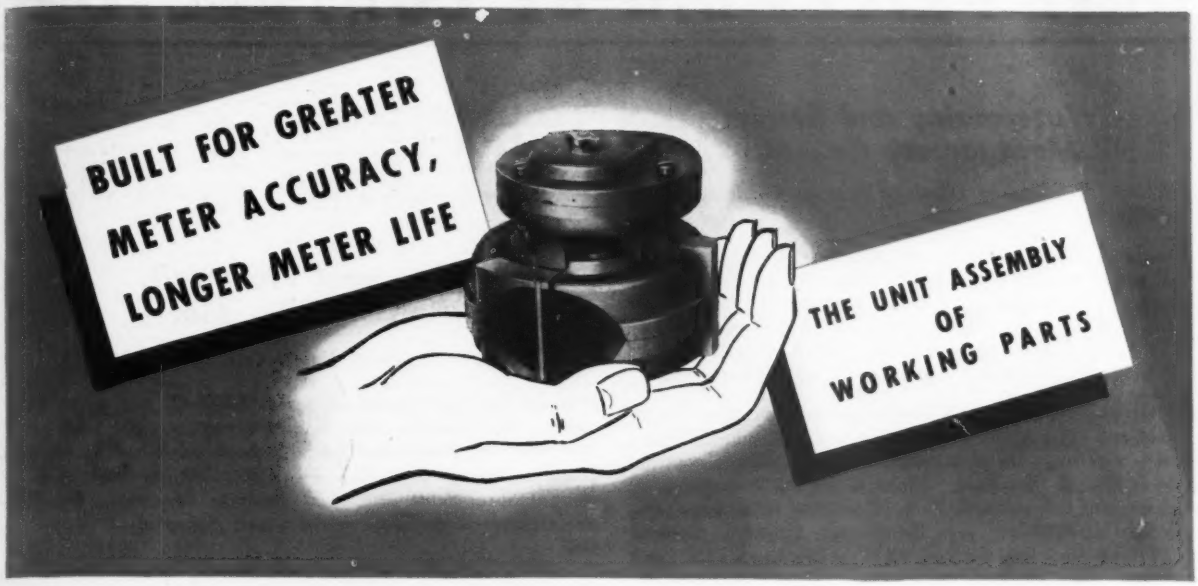

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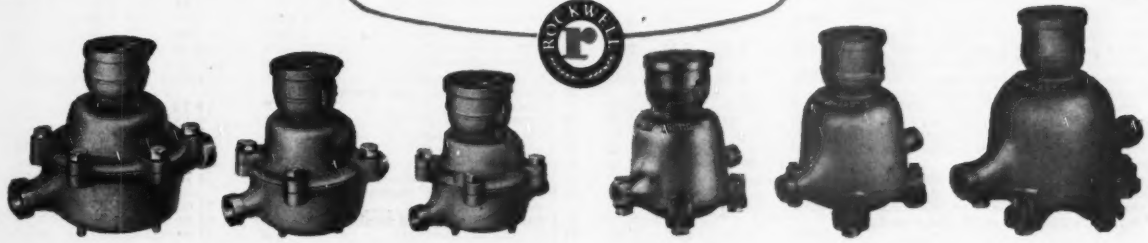

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UNIT PRICES BID BY CONTRACTOR

Watermains and Sewers, Montgomery Co., Md.

OWNER: Washington Suburban Sanitary Commission, Hyattsville, Md.

PROJECT: Installation of watermains, sewers and water and sewer house connections in Montgomery County, Md. Project is located along Defense Highway approximately 2 miles east of Bladensburg. Work includes laying 5,900 ft. of 2″ to 8″ cast iron watermains and 6,500 ft. of 6″ to 10″ concrete pipe sewers and sewer house connections.

CONDITIONS: Owner will furnish all cast iron pipe, fittings, valves and valve boxes for watermains, and manhole frames, covers and steps for sewer manholes. Stipulated contract time is 176 calendar days. Access to job site is available by highway and Pennsylvania R. R. Prevailing labor wage rates per hr. in Baltimore are: bricklayers, $2.50; carpenters, $1.95; structural iron workers, $2.15; steamfitters, $2.00; and common labor, $1.10.

(*Contract Awarded March 19, 1948)

LIST OF BIDDERS:

1. *Intercounty Const. Co., Hyattsville, Md. $37,906.73
2. The M. Cain Co., Inc., Washington, D. C 41,287.40
3. Nickles Bros., Hyattsville, Md 47,329.20
4. L & S Const. Co., Inc. 54,386.80
5. Leo Butler Co., Silver Springs, Md 56,143.35
6. Ahl Bros. Const. Co., Inc 100,244.10

	Item	Quantity	Unit Prices (1)	(2)	(3)
1	Earth excav. & refill for cast iron watermains & fire hydrant connections, 6″	2,603 lf	$0.61	$0.75	$1.00
2	Earth excav. & refill for cast iron watermains & fire hydrant connections, 8″	3,033 lf	.66	.75	1.00
3	Earth excav. & refill for 6″ plain concr. or vit. pipe sewers, 0′–6′	50 lf	.74	1.50	2.00
4	Earth excav. & refill for 6″ plain concr. or vit. pipe sewers, 6′–8′	150 lf	.88	1.90	3.00
5	Earth excav. & refill for 6″ plain concr. or vit. pipe sewers, 8′–10′	220 lf	1.40	2.10	3.00
6	Earth excav. & refill for 6″ plain concr. or vit. pipe sewers, 10′+	10 lf	1.90	3.00	4.00
7	Earth excav. & refill for 8″ plain concr. or vit. pipe sewers, 0′–6′	202 lf	1.01	1.50	2.00
8	Earth excav. & refill for 8″ plain concr. or vit. pipe sewers, 6′–8′	207 lf	1.12	1.90	2.00
9	Earth excav. & refill for 8″ plain concr. or vit. pipe sewers, 8′–10′	2,186 lf	1.81	2.10	3.00
10	Earth excav. & refill for 8″ plain concr. or vit. pipe sewers, 10′–12′	1,177 lf	2.16	2.20	3.50
11	Earth excav. & refill for 8″ plain concr. or vit. pipe sewers, 12′+	10 lf	3.12	3.50	5.00
12	Earth excav. & refill for 10″ plain concr. or vit. pipe sewers, 0′–6′	10 lf	1.76	1.60	3.00
13	Earth excav. & refill for 10″ plain concr. or vit. pipe sewers, 6′–8′	10 lf	1.94	1.80	3.00
14	Earth excav. & refill for 10″ plain concr. or vit. pipe sewers, 8′–10′	105 lf	2.87	2.20	3.50
15	Earth excav. & refill for 10″ plain concr. or vit. pipe sewers, 10′–12′	1,338 lf	3.37	3.00	3.50
16	Earth excav. & refill for 10″ plain concr. or vit. pipe sewers, 12′–14′	162 lf	4.73	3.80	6.00
17	Earth excav. & refill for 10″ plain concr. or vit. pipe sewers, 14′+	10 lf	5.70	4.00	10.00
18	Earth excav. & refill for 6″ plain concr. or vit. pipe house conn. & water house conn., 0′–6′	200 lf	1.52	1.60	3.00
19	Earth excav. & refill for 6″ plainconcr. or vit. pipe house conn. & water house conn., 6′–8′	200 lf	1.56	1.90	3.00
20	Earth excav. & refill for 8″ plain concr. or vit.pipe house conn. & water house conn., 8′–10′	250 lf	2.26	2.50	3.00
21	Earth excav. & refill for 8″ plain concr. or vit. pipe house conn. & water house conn., 10′–12′	150 lf	2.64	3.20	3.50
22	Earth excav. & refill for 6″ plain concr. or vit. pipe house conn. & water house conn., 12′+	50 lf	3.11	4.50	5.00
23	Laying c.i. watermains & fire hydrant conn., 2″	270 lf	.44	.30	.50
24	Laying c.i. watermains & fire hydrant conn., 6″	2,603 lf	.51	.60	.50
25	Laying c.i. watermains & fire hydrant conn., 8″	3,033 lf	.63	.70	.50
26	Setting fire hydrants	3 ea	30.00	40.00	50.00
27	Furn. & laying plain concr. or vit. pipe sewers, 6″	430 lf	1.07	1.60	1.50
28	Furn. & laying plain concr. or vit. pipe sewers, 8″	3,782 lf	1.52	1.80	1.60
29	Furn. & laying plain concr. or vit. pipe sewers, 10″	1,635 lf	1.96	2.00	1.80
30	Furn. & laying p. concr. or vit. pipe sewer house conn.	700 lf	1.10	1.40	1.50
31	Furn. & placing concr. or vit. "T" & "Y" branches, 6″x6″ on sew. & sew. house conn.	16 ea	5.69	7.00	10.00
32	Furn. & placing concr. or vit. "T" & "Y" branches, 8″x6″, on sew. & sew. house conn.	14 ea	11.61	9.00	10.00
33	Furn. & placing concr. or vit. "T" & "Y" branches, 10″x6″, on sew. & sew. house conn.	4 ea	13.87	12.00	12.00
34	Building manholes	220 lf	23.90	23.00	24.00
35	Build. drop conn. at manholes, type "A", 6″	1 ea	21.17	35.00	80.00
36	Build. drop conn. at manholes, type "A", 8″	3 ea	27.74	40.00	80.00

Levee and Floodwall, Kansas City, Mo.

OWNER: U. S. Engineers, Kansas City, Mo.

PROJECT: Construction of levee floodwall and appurtenances, East Bottoms Unit, located along the right bank of the Missouri River and the left bank of the Big Blue River at Kansas City, Mo. Work includes construction of levee embankment, reinforced concrete floodwalls, drainage structures, drainage systems, and riprap slope protection.

CONDITIONS: All plant, labor, materials and equipment to be furnished by contractor. Access to job site is available by rail, highway and water. Contractor must commence work within fifteen calendar days after receipt of notice to proceed and must complete work ready for use within 640 calendar days after given notice to proceed. Stipulated labor wage rates per hr. are: skilled labor, ranging from $2.125 to $2.50; semi-skilled, from $1.60 to $1.80; and common, $1.325.

(*Contract Awarded March 18, 1948)

LIST OF BIDDERS:

1. *Clarkson Const. Co., Kansas City, Mo. $2,400,628.50
2. George Bennett Const. Co., Kansas City, Kan 2,514,779.52
3. S. J. Groves & Sons, Co., Minneapolis, Minn. 2,803,858.50
4. Condon-Cunningham Co., Omaha, Neb. 2,818,873.00
5. R. B. Potashnick, Cape Girardeau, Mo. and O'Dell & Riney Const. Co., Inc., Kirkwood, Mo. 3,665,944.50

	Item	Quantity	Government Estimate	Unit Prices (1)	(2)
1	Clearing and grubbing	lump sum	$36,615 05	$50,000.00	$90,000.00
2	Unclassified excavation	161,000 cy	.520	.40	.50
3	Drainage trench excavation, above 11-ft. depth	210,300 cy	.258	.35	.26
4	Drainage trench excavation, below 11-ft. and above 18-ft. depth	14,200 cy	3.55	4.00	3.52
5	Structural excavation	19,800 cy	1.081	.85	4.00
6	Impervious fill	545,300 cy.	.435	.56	.655
7	Pervious fill	1,340,000 cy.	.484	.56	.60
8	Pervious berm fill	91,000 cy	.522	.56	.66
9	Drainage trench backfill	194,900 cy	.449	.60	.24
10	Structural backfill	16,000 cy	.709	2.00	1.10
11	Rolling for each two additional passes	3,000 sq	.04	.08	.10
12	Filter gravel for drainage system	28,250 cy	5.60	6.00	6.60
13	Filter under riprap	25,100 ton	2.83	3.25	2.50
14	Stone for riprap	41,400 ton	2.92	3.25	3.25
15	Perforated corrugated metal pipe —12″	1,700 lf	2.37	2.75	2.52
16	Perforated pipe—15″	21,000 lf	2.80	3.00	2.95
17	Perforated pipe—18″	2,190 lf	3.34	3.40	3.55
18	Perforated pipe—21″	1,420 lf	3.91	3.80	4.07
19	Perforated pipe—24″	2,040 lf	5.24	4.80	5.38
20	Perforated pipe—30″	2,360 lf	6.40	5.65	6.65
21	Perforated pipe—36″	400 lf	7.66	6.60	7.85
22	Corrugated metal pipe—10″	40 lf	2.66	4.00	5.05
23	Corrugated metal pipe, paved invert—24″	130 lf	5.39	5.30	5.59
24	Corrugated metal pipe—30″	20 lf	6.10	5.50	6.47
25	Corrugated metal pipe—36″	1,300 lf	7.54	6.50	7.63
26	Vitrified clay pipe—24″	30 lf	6.81	2.50	6.72
27	Cast iron pipe—24″	470 lf	21.45	15.00	21.40
28	Vitrified clay curved liner—42″	165 lf	4.72	4.30	6.70
29	End section for 24″ corrugated metal pipe	2 ea	31.00	35.00	41.50
30	Cut-off collar, corrugated metal	7 ea	87.41	85.00	171.80
31	Flap gate, 15″, 10-ft. head	9 ea	47.69	45.00	50.00

(*Continued on page* 85)

Levee and Floodwall, Kansas City, Mo.

Continued from page 82

32	Flap gate, 30", 10-ft. head	2 ea	123.48	105.00	132.00
33	Flap gate, 42", 10-ft. head	1 ea	231.93	190.00	228.00
34	Flap gate, 24", 30-ft. head	4 ea	201.50	280.00	215.00
35	Flap gate, 42", 30-ft. head	1 ea	397.77	535.00	441.00
36	Flap gate, 54", 30-ft. head	1 ea	717.12	920.00	763.00
37	Sluice gate, 24"	4 ea	599.70	645.00	740.00
38	Sluice gate, 30"	1 ea	641.96	750.00	737.00
39	Sluice gate, 36"	1 ea	784.47	850.00	856.00
40	Sluice gate (wood), 42"	1 ea	842.86	1,070.00	1,024.00
41	Sluice gate, 54"	1 ea	1,437.61	1,680.00	1,510.00
42	Access manhole, 30" diameter	16 ea	213.68	260.00	309.73
43	Access manhole, 36" diameter	4 ea	231.66	340.00	387.45
44	Access manhole, 42" diameter	2 ea	246.06	385.00	437.85
45	Access manhole, 48" diameter	1 ea	261.64	460.00	525.00
46	Additional height, 30" manhole	60 lf	10.57	15.00	12.28
47	Additional height, 36" manhole	37 lf	12.05	16.00	14.07
48	Additional height, 42" manhole	3 lf	15.77	18.00	15.85
49	Additional height, 48" manhole	10 lf	16.65	20.00	17.64
50	Concrete in flood wall	3,050 cy	24.04	44.00	31.20
51	Concrete in drainage structures	2,250 cy	39.75	55.00	62.00
52	Steel reinforcement	587,000 lb	.093	.105	.13
53	Miscellaneous metals	29,000 lb	.43	.37	.55
54	Copper water stops	1,120 lf	.94	2.80	3.25
55	Rubber water stops	990 lb	3.80	4.20	2.85
56	Removal of 52" brick sewer and head wall, station 4/66.85	188 lf	17.09	52.50	14.00
57	Removal of 24" r.c.p. sewer and head wall, station 67/64.6	81 lf	10.86	30.00	5.10
58	Removal of 42" concrete pipe and partial removal of outlet structure, station 75/55.28	157 lf	13.49	27.50	9.00
59	Timber stop logs	430 f bm	.34	.55	.50
29	R.C. pipe, 18", extra-strength	90 lf	18.08	25.00	22.00
30	Extension, 15th Street sewer	50 lf	31.54	50.00	18.10
31	Plugging, 14th to 15th Street main	lump sum	321.36	504.00	2,100.00
32	Alteration, 11th Street lateral	lump sum	94.27	240.00	900.00
33	Burt Street sewer repair, Sta. 26+52	lump sum	857.39	640.00	450.00
34	R.C. discharge pipe, 30", pumping sta. No. 3	54 lf	34.97	33.00	44.00
35	Connection—6"	12 ea	97.44	35.00	60.50
36	Connection—8"	2 ea	78.35	45.00	66.00
37	Connection—10"	3 ea	155.96	50.00	77.00
38	Connection—12"	3 ea	190.68	70.00	88.00
39	Connection—15"	3 ea	113.24	85.00	121.00
40	Reconnection to inlet	1 ea	27.66	214.00	55.00
41	Standard manhole	16 ea	382.26	550.00	264.00
42	Standard manhole with grate cover	1 ea	388.76	600.00	264.00
43	Additional depth of standard manhole	80 vf	50.07	55.00	19.80
44	Drop manhole	6 ea	471.56	640.00	352.00
45	Additional depth of drop manhole	30 vf	63.30	70.00	26.40
46	Grate inlet	2 ea	177.08	470.00	330.00
47	Additional depth of grate inlet	7 vf	26.84	55.00	30.00
48	Pressure type manhole	12 ea	231.29	635.00	600.00
49	Additional depth of pressure type manhole	37 vf	38.38	48.00	40.00
50	Sealing inlet, 2" to 8"	16 ea	11.17	12.00	40.00
51	Sealing inlet, 10" to 18"	20 ea	18.46	20.00	56.00
52	Sealing inlet, 20" to 29"	5 ea	33.42	30.00	73.00
53	Sealing inlet, 30" to 48"	6 ea	30.63	60.00	150.00
54	Sealing construction joints	1,700 lf	4.42	1.40	4.75
55	Backflow check device, 8" pipe	1 ea	2,028.55	1,900.00	3,000.00
56	Backflow check device, 10" pipe	1 ea	3,299.78	2,500.00	3,100.00
57	Backflow check device, 12" pipe	1 ea	1,920.11	3,000.00	3,200.00
58	Bearing piling	2,422 lf	2.10	2.50	3.10
59	Pumping station No. 1	lump sum	56,604.92	74,299.00	96,000.00
60	Pumping station No. 2	lump sum	27,501.85	32,208.00	45,000.00
61	Pumping station No. 3	lump sum	34,151.28	33,834.00	49,000.00
62	Pumping station No. 4	lump sum	52,301.48	64,488.00	75,000.00

* Without profit.

Sewers and Pumping Stations, Omaha, Nebraska

OWNER: U. S. Engineers, Omaha, Nebraska; Col. L. W. Prentiss, engineer.

PROJECT: Burt-Izard Street sewers and pumping stations, located in the river bottom land adjacent to the west bank of the Missouri River at Omaha. Work includes installation of 2,692 lin. ft. of reinforced concrete pipe, from 15" to 36"; 780 lin. ft. of vitrified clay pipe, from 8" to12"; and 460 lin. ft. of cast iron pipe, from 6" to 8".

CONDITIONS: Access to job site is available by rail, highway, and water. Stipulated contract time is 420 days from date of notice to proceed. Prevailing labor wage rates per hr. are: skilled labor, up to $1.54; semi skilled, ranging from $1.10 to $1.25; and common, $.85 and $.90.

(*Contract Awarded April, 1948)

LIST OF BIDDERS:

1. *Korshoj Const. Co., Blair, Neb. $615,948.00
2. Condon-Cunningham Co., and Peter Kiewit Sons' Co., Omaha, Neb. 772,585.50
3. Iowa Bridge Co. & Peter N. Kruse, Des Moines, Iowa 897,770.00

			Unit Price		
	Item	Quantity	Government Estimate	(1)	(2)
1	Pavement removal	3,000 sy	$1.60	$3.80	$0.90
2	Unclassified excavation, Izard trunk	9,600 cy	1.83	1.50	6.30
3	Unclassified excavation, Burt trunk	350 cy	10.01	11.00	42.00
4	Removal of Izard Street sewer	1,019 lf	5.15	6.00	17.50
5	Removal of Burt Street sewer	100 lf	75.43	60.00	52.25
6	Backfill	9,500 cy	1.17	3.60	3.80
7	Crushed rock for surfacing	350 cy	6.24	19.00	9.00
8	Izard Street pressure sewer	1,019 lf	147.25	161.00	197.10
9	Transition section, Izard Street	lump sum	10,676.11	8,450.00	12,190.00
10	Burt Street pressure sewer	100 lf	260.27	210.00	285.00
11	R.C. pipe, 30", 10.1' to 12' deep	10 lf	14.34	56.00	33.00
12	R.C. pipe, 30", 12.1' to 14' deep	50 lf	15.00	56.00	38.50
13	R.C. pipe, 18", 8.1' to 10' deep	400 lf	14.69	25.00	15.18
14	R.C. pipe, 18", 10.1' to 12' deep	600 lf	16.78	26.50	18.15
15	R.C. pipe, 18", 12.1' to 14' deep	100 lf	17.93	50.00	21.45
16	R.C.pipe, 15", 8.1' to 10' deep	30 lf	7.04	23.00	13.73
17	V.C. pipe, 12", 6.1' to 8' deep	500 lf	5.95	11.50	9.35
18	V.C. pipe, 12", 8.1' to 10' deep	50 lf	5.71	15.00	12.64
19	V.C. pipe, 8", 0' to 6' deep	60 lf	4.10	7.50	4.95
20	V.C. pipe, 8", 6.1' to 8' deep	150 lf	4.36	11.00	7.10
21	V.C. pipe, 8", 8.1' to 10' deep	20 lf	6.23	15.00	10.45
22	C.I. pipe, 8", 0' to 6' deep	130 lf	13.15	18.50	7.10
23	C.I. pipe, 8", 6.1' to 8' deep	250 lf	16.26	25.00	9.30
24	C.I. pipe, 6", 0' to 6' deep	50 lf	13.18	10.00	6.00
25	C.I. pipe, 6", 6.1' to 8' deep	30 lf	16.17	17.00	8.30
26	R.C. pipe, 36", interceptor No. 1A	960 lf	13.59	14.20	28.60
27	R.C. pipe, 36", interceptor No. 1C	120 lf	19.48	31.00	26.40
28	R.C. pipe, 30", extra-strength	178 lf	13.55	42.00	33.00

Flood Control Levee, Missouri

OWNER: U. S. Engineers, Kansas City, Missouri; Colonel Paul D. Berrigan, District Engineer.

PROJECT: Construction of 11.5 miles of earthen levee located along the left bank of the Missouri River in Holt County, near Forbes, Missouri. The levee will average 13.3 ft. in height, with a ten-foot crown, and side slopes of 1 on 3 on the river side and 1 on 4 on the land side, with provision of a two-foot freeboard above the design flood after the earth has settled. This is the first of eighty of the "Pick-Sloan" levees to be constructed within the Kansas City District.

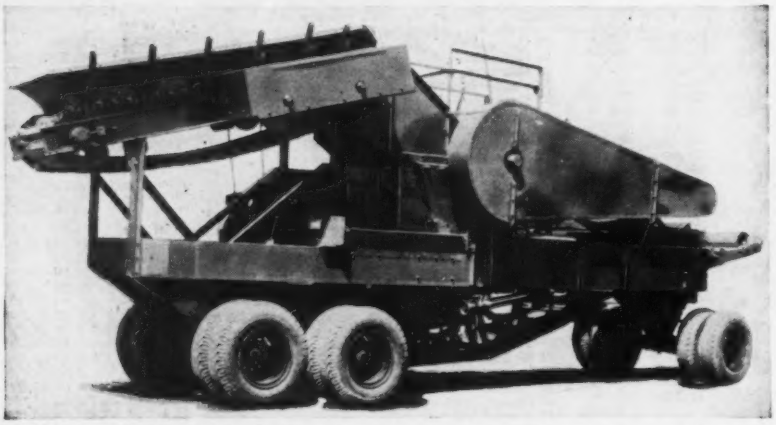
CONDITIONS: The owner will furnish all plant, labor, materials and equipment and perform all work for the construction of the levee. Access to the job site is available by rail, highway and water. Stipulated contract time is 375 calendar days. Prevailing wage rates are: skilled, $1.05 to $1.75 per hour; semi-skilled, $1.00; common, $.90.

LIST OF BIDDERS: (*Contract Awarded May 24, 1948)

1. *Porter DeWitt Construction Co., Poplar Bluff, Mo $918,182.40
2. Gould & Cross, Grand Rapids, Mich. 983,449.00
3. List & Clark Construction Co., Kansas City, Mo. 1,038,091.40
4. Perry McGlone Construction Co., Kansas City, Mo. 1,041,693.60
5. Francis R. Orshek, Inc., Fremont, Neb. 1,079,484.00
6. S. J. Groves & Sons Co., Minneapolis, Minn. 1,148,441.30
7. Condon-Cunningham Co., Omaha, Neb. 1,196,471.00

			Unit Prices		
	Item	Quantity	Government Estimate	(1)	(2)
1	Clearing and grubbing	lump sum	$34,521.73	$84,000.00	$50,000.00
2	Common excavation	106,000 cy	.214	.25	.30
3	Semi-compacted fill	1,644,000 cy	.363	.35	.40
4	Rolling for additional compaction	1,000 rol hr	3.75	8.00	8.00
5	Water for embankment compaction	75 M gal	3.99	10.00	7.00
6	Filter under riprap	6,520 ton	3.51	3.10	5.00
7	Stone for riprap	11,800 ton	4.19	3.10	5.00
8	Concrete	520 cy	45.13	60.00	50.00
9	Steel, reinforcement	47,000 lb	.101	.11	.12
10	Structural excavation	6,000 cy	1.50	1.25	1.00
11	Structural backfill	6,500 cy	1.19	1.25	.50
12	Corrugated metal pipe—24"	82 lf	4.36	5.70	8.00
13	Corrugated metal pipe—48"	134 lf	14.86	20.00	17.00
14	Corrugated metal pipe—54"	396 lf	22.73	28.00	25.00
15	Corrugated metal pipe—72"	1,362 lf	29.21	35.00	35.00
16	Cut-off collars	34 ea	164.27	190.00	150.00
17	Flap gate—24"	1 ea	107.34	200.00	200.00
18	Sluice gate—48"	1 ea	1,140.49	1,600.00	1,500.00
19	Sluice gate—54"	3 ea	1,348.77	1,900.00	1,700.00
20	Sluice gate—72"	12 ea	2,279.01	3,100.00	2,500.00
21	Miscellaneous metal	2,100 lb	.51	.80	.30

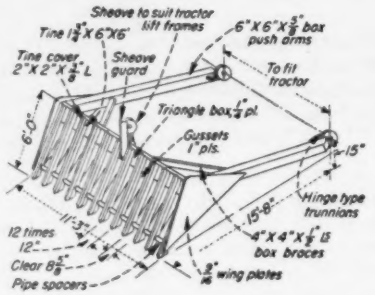
NEW PRODUCTS



CRUSHING AND SCREENING PLANT —Semi-portable duplex plant has jaw crusher and roll crusher together with folding bucket elevator and power unit, all mounted on structural steel chasis with steel wheels although pneumatic tires are optional. Additional units consist of three-deck 3x10-ft. vibrating screen mounted atop a 20-cu. yd. three-compartment steel storage bin and a return conveyor from screen to roll crusher. Plant is rated at normal capacity of 40 to 50 tons per hr. Hopper-fed primary crusher will take rock up to 12 in.—**Pioneer Engineering Works, Inc., Minneapolis 3, Minn.**

DIESEL TRACTOR—New track-type unit of 130 drawbar horsepower features five-speed constant-mesh transmission and three reverse speeds. Recommended for bulldozing, scraper loading and hauling. Separate gear-type oil pump, providing pressure lubrication for bearings and an oil spray over the gear, is provided for the new transmission. Powerful lightweight master clutch with large diameter brake reduces inertia for faster shifting. New drum-type front idler strengthens the rim. Forward travel speeds range from 1.7 to 4.8 mph. and reverse speeds from 2.2 to 3.7 mph. Engine is four-cycle, water-cooled, six cylinder diesel unit. Overall length is 15 ft. 3 in. Gage, center to center tracks, is 78 in. Starting is done with independent two-cylinder vertical gasoline engine.—*Caterpillar Tractor Co., Peoria, Ill.*

AXLE SHIFT CONTROL—Automatic electric shift now available for Eaton heavy-duty, two-speed axles used on trucks with capacity of 3 tons or more, permits driver to change from low to high axle ratio and back by flick of finger without declutching or releasing accelerator. Advantages: (1) Assures more positive action with less possibility of failure; (2) easier to service and simpler to install. Also available is semi-automatic electrical control which requires clutch and accelerator action but is more positive than present shifts. —*Eaton Manufacturing Co., Cleveland, Ohio.*



ROCK RAKE—Designed for use on the D-7 and D-8 tractors in place of the dozer and to be used like a bulldozer, this rock rake has been found very satisfactory for removal of oversize rock from embankment material in place and for consolidation of shot rock in borrow areas. The rake width is 11 ft. 3 in. and its 12 times are 8⅝ in. clear space apart. Construction of the rock rake permits rather rough usage and eliminates the wedging of rock previously encountered.—*F. W. McCoy Co, 2 Santa Fe Drive, Denver, Colo.*

HOLE DIGGER — Manufactured in both automatic and manually operated models, "Speedigger" can be mounted on all tractors or jeeps. Standard model digs 9 in. hole up to 24 ft. deep. For setting utility poles, machine digs 12 in. hole to 6½ ft. depth. Standard models are furnished with 12 in. or 8 in. diameter augers; other sizes are available.—*R. J. Piper Mfg. Co., Princeton, Ill.*

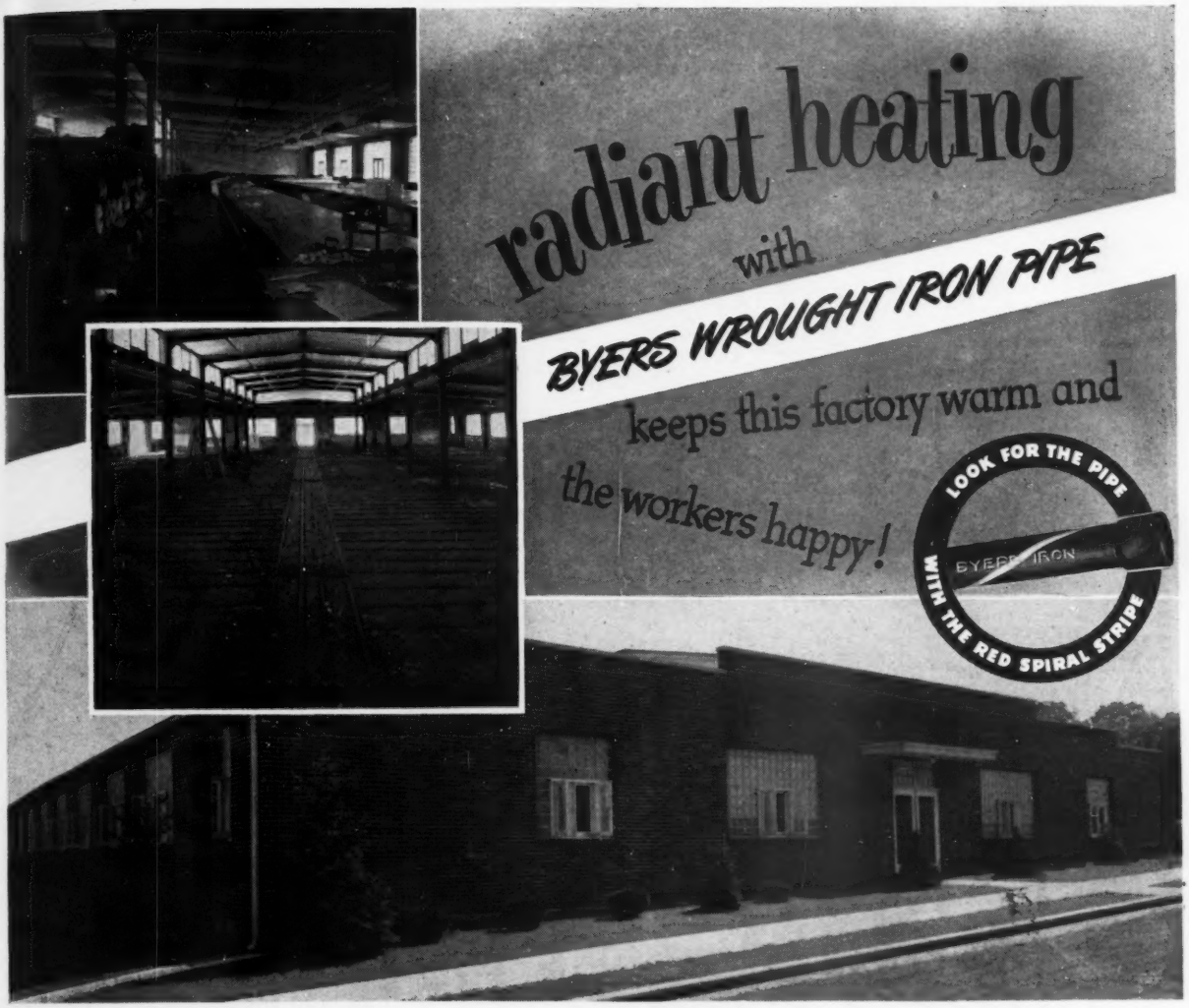
CONCRETE POURING BUCKET—Rectangular bucket has air-operated roller gates and controllable discharge. Larger sizes are dual units formed by coupling together two 4-cu. yd. buckets with combined capacity of 8 cu. yd. Buckets are available in the following sizes: single, 2-4 cu. yd.; dual, 6-8 cu. yd. Buckets are rectangular, with vertical sides and controllable discharge. Any portion of bucket load of concrete can be discharged at desired location.—*Blaw-Knox Co., Pittsburgh, Pa.*

DIESEL ENGINE — Multiple engine unit (Model 8–103) consists of two General Motors, Series 71, 4-cylinder diesels mounted side by side on a common base and geared to a single output shaft. Unit develops 170 bhp. to fill gap between single 6-cylinder and twin-6 models in the GM Series 71 line. Purchasers have a selection of four different power takeoff arrangements including pulley or chain drive and stub shaft, SAE "O" size housing and drive flange. Units may be equipped with electric, air or gasoline starting devices. —*Detroit Diesel Engine Division, General Motors Corp., 13400 West Outer Drive, Detroit 28, Mich.*

DITCHING MACHINES — Two new machines (models 720 and 710) feature three-position boom quickly adjustable to dig close to obstructions. Model 720 is for digging trenches 8 to 11 in. wide and up to 4 ft. deep. It is of vertical boom design. Digging speeds are as high as 32 ft. per min. Spoils conveyor is adjustable to either side. Model 710 is for trenches up to 5½ in. wide and 42 in. deep. Both machines are equipped with overload release to prevent damage from heavy boulders. Booms are equipped with hydraulic hoists for power lift and controlled gravity lowering.—*Barber-Green Co., Aurora, Ill.*

FRONT END LOADER—New type small front-end loader is mounted on own 3-wheel tractor, air-cooled gas engine powered, hydraulic controlled. Load is concentrated on two front wheels, where traction power is applied; steering is through single rear wheel. Hoist will lift and dump 6-cu. ft. —*Arrow Contractors Equip. Co., 2020 Walnut St., Chicago 12, Ill.*

(*Continued on page* 88)



The "New Look" that modern design gives to today's industrial structures has a parallel in the new look that management is giving to features affecting working conditions. In the rayon underwear factory of Campbell & Helmich, Inc. at Boyertown, Pa., the owners recognized the dollar value of employee comfort, and specified radiant heating, using Byers Wrought Iron pipe for the floor coils. The system was designed by Carl M. Snyder of Corbits, Inc., and installed by Warren F. Smith, heating contractor.

RESULTS EXCELLENT

The owner reported some very interesting results. Not one complaint regarding colds and drafts was registered. Even in midwinter, the "head-level" temperature was not stuffy, (floor temperature—80°, Air temperature—70°) and as a consequence the organization was more alert, and output efficiency was greater, than had been the case in the former factory where a different type of heating was used. Lost time due to colds was almost nil. The owners felt that humidity conditions were better (no ventilation was used but natural type). The accumulation of lint or factory dust on light fixtures was negligible. And the economy of operation was greater than anticipated.

SPECIAL QUALITIES

The use of wrought iron follows established engineering practice, and brings a number of advantages in installation and in use. Wrought iron is easily formed and welded. It has a high rate of heat emission. It expands and contracts at practically identical rates with concrete, minimizing the danger of thermal cracks and loss of bond. And its corrosion resistance has been convincingly demonstrated.

FULL DATA IS AVAILABLE

If you are considering an installation, our bulletin "Byers Wrought Iron for Radiant Heating "will give you complete information on principles, calculation, layout methods, and results. Ask for a copy.

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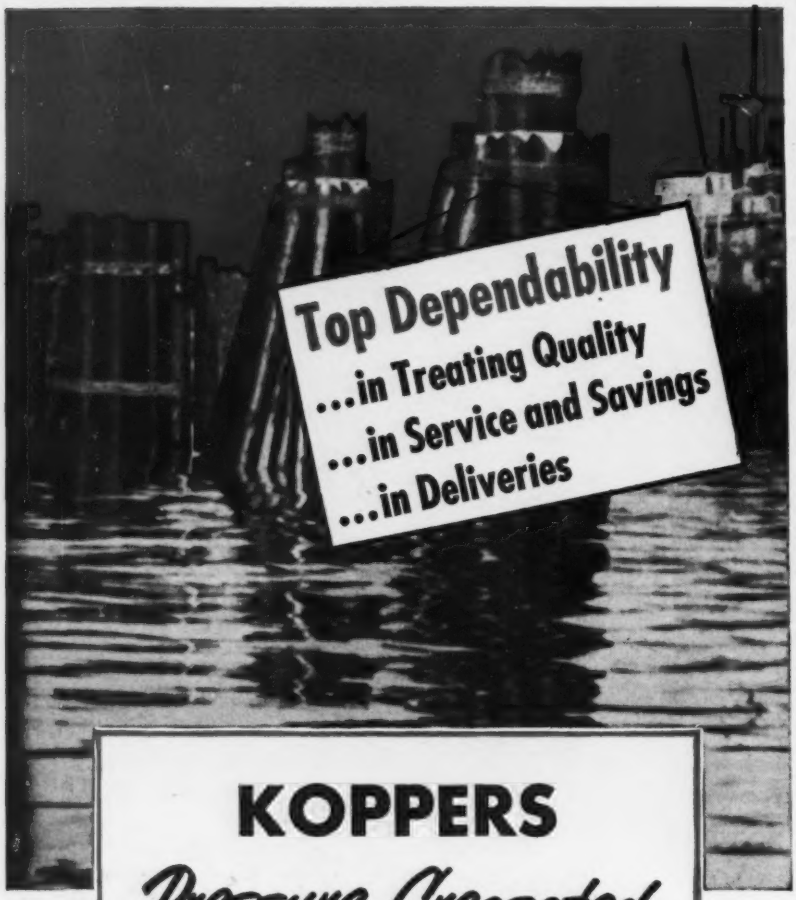
CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



KOPPERS

Pressure-Creosoted Piles

Koppers Pressure-Creosoted Piles Deliver service-proved protection against the marine borers that are a constant threat in every United States port. Marine borers in one year caused $3,000,000 worth of damage in a single American harbor. No guess nor gamble—Pressure-Creosoted Piles are still sound after 20 years and more in water where untreated piles were honey-combed in 6 months.

Koppers Treating Plants Deliver on schedule, have a top reputation for keeping promises and maintaining shipping dates . . . Quotations gladly furnished.

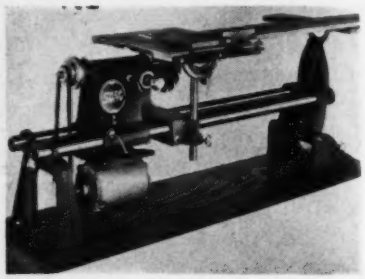
KOPPERS

PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC.

PITTSBURGH 19, PA.

PUSHER AND BULLDOZER — High-speed machine for dozer and pusher loading is 300 hp. unit on 24x29 ground grip tires with a top speed of 13.6 mph. both forward and reverse. The Tournadozer has four forward or reverse speeds made possible by constant mesh principle in transmission design. Electrically operated blade control is feature of 25-ton tractor dozer. Source of electrical current is a 240-v., 120 cycle a.c. generator built in line with the diesel engine. Height blade can be raised above ground is 3 ft. 10 in.. Approximate shipping weight is 50,700 lb. Overall dimensions are: width, (blade mounted) 13 ft. 10 in.; length, 19 ft. 7 in.; wheel-base, 7 ft. 6 in.; gage, 8 ft. 10½ in. Machine is recommended as a pusher unit with large scrapers.—*R. G. LeTourneau, Inc., Peoria, Ill.*



COMBINATION POWER TOOL— Adaptable for use as circular saw, lathe, sander, router, grinder and, by tilting hinge at right, a vertical drill press. Weighs 175 lb. Dimensions of shopsmith in horizontal position are 59 x 18 x 21 in. Supplied with or without ½ hp. motor operating at 1750 rpm. Designed primarily for light work.—*Magna Engineering Corp., 465 California St., San Francisco, Calif.*

WAGON JACK—A new lightweight wagon drill combines the drilling stability of a wagon drill with the portability of a jackhammer. The machine can be moved, set up and operated by one man. An adjustable mounting permits the drilling of holes at any angle. It will drill more feet of hole per cu.ft. of air consumed than a hand-held drill.—*Ingersoll-Rand, 11 B'way, N. Y. 4, N. Y.*

AIRLINE HEATER — Weighing only four pounds, this heater supplies comfortably warm, thermostat-controlled air to breathe even in temperatures of 30 degrees below zero. The units consist of an electric heater, heat exchanger and thermostat enclosed in a rubber covered cylinder 11 in. long, outside diameter 2½ in., to be worn clipped to the rear of the user's belt. There is no interference with the worker's movements.—*Mine Safety Appliances Co., Pittsburgh, Pa.*

(*Continued on page* 90)

SMITH Impulse Turbines

Impulse runner of *solid-cast* design, an exclusive SMITH advantage.

FOR HIGH HEADS, and wherever the head and water quantities available prohibit the use of reaction-type machines. Ideal for installations in remote localities because of the ease with which the completed unit may be transported. The simplicity of design, facility of operation and greater dependability remove the necessity for skilled operators and attendants. Smith's solid-cast runner design provides the additional advantages of closer spacing of buckets resulting in increased speed and consequently, a decrease in the size of the turbine unit, as well as the generator. Write for your copy of our Bulletin— "Impulse Turbines by SMITH!"

S. MORGAN SMITH COMPANY
YORK, PENNSYLVANIA

POWER by SMITH

"Answer this question, Homer Sneet, And you'll be living on Easy Street!"

Emcee: "How much does it cost, by Air Express
To ship 10 pounds 1200 miles, no less?"

Homer: "Why didn't you ask me that *before?*
All it costs is $3.84!

"I use it many times each day—
It's the fastest possible way to make hay!
Easy Street's *already* my address,
Thanks to Scheduled Airline Air Express.

"What's more you get *door-to-door* service, too
—And all at *no extra cost* to you.
In these days of price inflation
Air Express rates are cause for elation!"

Specify Air Express—World's Fastest Shipping Service

- Low rates—special pick-up and delivery in principal U. S. towns and cities at no extra cost.
- Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.

True case history: Truck and auto parts comprise big portion of Air Express shipments. Keep equipment rolling! Typical 36-lb. shipment picked up Detroit late afternoon, delivered Salt Lake City noon next day. 1507 miles, Air Express charge $16.58. Any distance similarly inexpensive. Phone local Air Express Division, Railway Express Agency, for fast shipping action.

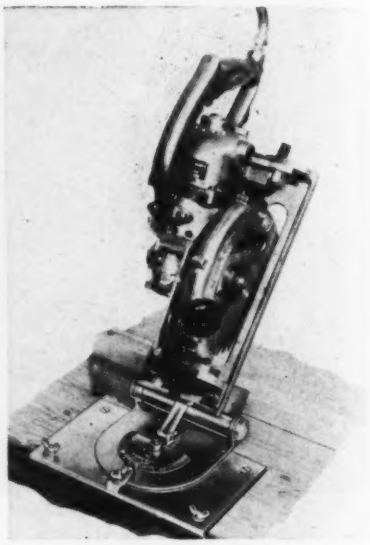
AIR EXPRESS
GETS THERE FIRST

Rates include pick-up and delivery door to door in all principal towns and cities

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE

SCHEDULED AIRLINES OF THE U. S.

FOOT RESTS for attachment to tractor, stationary engine or other platform on which operator must stand consists of thick, rubber mats which fasten with ¼-in. cap screws. Said to eliminate jar and fatigue from standing on hard surfaces. Specially designed safety tread of foot rest gives maximum traction and lessens accidents from slipping. Dimensions, 12 in. long, 6 in. wide, 1 in. thick—*Waterloo Foundry Co., Waterloo, Iowa.*

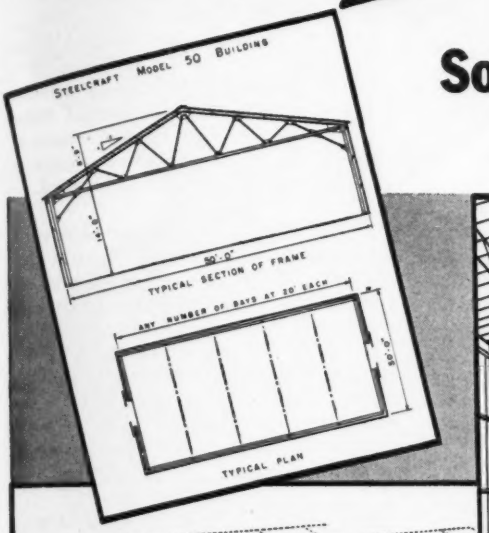


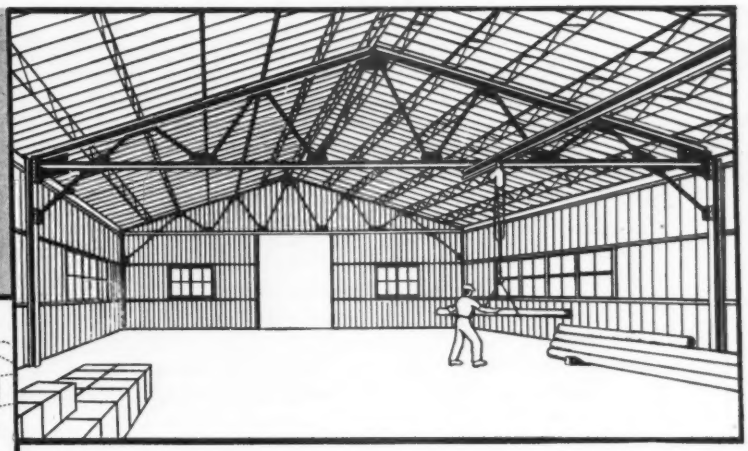
SAW MOUNT—Designed to convert any electric hand saw into a rigid precision tool for making cuts at any angle, mount comes with two round and two slotted holes for easy attachment to any 6 to 12-in. portable electric saw. Saw is attached to mount by boring two holes in saw base plate and bolting. Saw mount is being marketed under trade name of "Jiffix."—*Durham Bros., P. O. Box 620, Oakland, Calif.*

LIGHTWEIGHT BUILDING MATERIAL, named Durisol, is made of chemically treated and unpregnated wood fibers mixed with Portland cement with built-in insulation, sound proofing, fireproofing and waterproofing. It is available in panels, slabs and blocks and can be used for exterior walls, floors, roofs and ceilings. Durisol wall 4 in. thick is said to be equal in insulation value to a 20-in. wall of brick and mortar. Other advantages: (1) Construction time cut in half; (2) no mortar needed; (3) only half number of studs necessary, saving lumber; (4) dry-wall construction possible as only strip of felt only is used between tongue-and-grooved panels to make them watertight—*Durisol, Inc.*, 420 *Lexington Ave., New York City.*

(*Continued on p.* 92)

Amazing new METAL BUILDING
WITH 50 FOOT CLEAR SPAN
Solves your warehouse and production space problems!





A METAL BUILDING OR SEPARATE STRUCTURAL FRAMEWORK FOR EVERY NEED!

- Manufacturing Plants
- Warehouses
- Storage Buildings
- Foundries
- Commercial Garages
- Chemical Plants
- Oil Refineries
- Repair Shops
- Railroad Shops

LET OUR EXPERIENCED ENGINEERS MAKE A SURVEY OF YOUR BUILDING NEEDS . . . AT NO CHARGE!

Delivered to you *NOW!*

- **Permanent, Yet Easily Erected!**
- **Multiple Widths—Any Length!**
- **Remarkably Low Cost!**
- **Meets Local Building Codes!**

No matter what your need . . . regardless how urgent your demand . . . there is a STEELCRAFT Metal Building to meet *YOUR* requirements —available *right NOW!* Ruggedly permanent, yet easily erected with ordinary tools, STEELCRAFT Metal Buildings solve your space problems. STEELCRAFT 50 foot clear span buildings, engineered to meet local building codes, are furnished complete with ribbed aluminum side wall and roof panels; or, you can order the structural steel frame separately for use with various other types of wall and roof covering. Other STEELCRAFT buildings are available in sizes suited to your specific needs. Write now for complete information on the STEELCRAFT building line . . . or request our engineers to make a survey of your building problems.

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MANUFACTURING COMPANY
ROSSMOYNE, OHIO (IN GREATER CINCINNATI)

There's a Profitable Idea for You in—

The Case of the Old Offender

Draftsman: "You old reprobate, you spoiled a two hundred-dollar drawing! Look how brittle and opaque it is!"

Father time: "Yes, but you drew it on tracing paper — when you should have used Arkwright Tracing Cloth!"

It pays to use Arkwright Tracing Cloth instead of paper. It's a much safer habit, even for preliminary sketches and "one-job" drawings, supposedly temporary, that may be urgently needed later. Repeated usefulness and long years of permanence are your rich reward. This was dramatically proved when a perfect print was made recently from an 80-year old tracing on cloth made by the same process regularly employed by Arkwright!

Send for working samples and prove to yourself how much better Arkwright is for all drawings. Arkwright is sold by leading drawing material dealers everywhere. Arkwright Finishing Co., Providence, R. I.

The Big Six Reasons Why Arkwright Tracing Cloths Excel

1. Erasures re-ink without feathering.
2. Prints are always sharp and clean.
3. Tracings never discolor or go brittle.
4. No surface oils, soaps or waxes to dry out.
5. No pinholes or thick threads.
6. Mechanical processing creates permanent transparency.

ARKWRIGHT

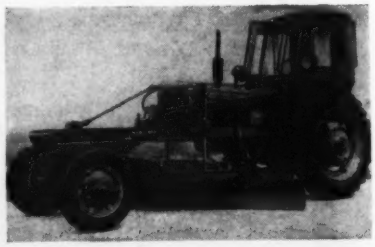
TRACING CLOTHS

AMERICA'S STANDARD FOR OVER 25 YEARS

CORNER WINDOW—Finestra corner window combination includes two large fixed panes at corner of house and one ventilating casement at each side of group, providing good cross ventilation. Vents operated by finger-tip control swing out to intercept breeze from several directions. Screening may be confined only to portion of window that opens and is provided by metal screens which are attached or removed from inside. These windows are standardized products.—*Detroit Steel Products Co., 3141 Griffin St., Detroit 11, Mich.*

ALUMINUM PAINT—A new paint contains active ingredients to prevent the growth of fungus and mold, and to resist termites and other boring insects. Used as a first coat on lumber, the paint is said to do the work of two or more ordinary treatments, serving as a wood preservative and as a priming coat.—*Aluminum Industries, Inc., Permite Paint Division, 2438 Beekman Street, Cincinnati, Ohio.*

HAND-HELD PENCIL SHARPENER—Small tool with hollow-ground cutting blade mounted in plastic case is called "Hold-'n' Hand" pointer pencil sharpener. A container catches the pencil shavings. "Stop" device indicates by feel when pencil is correctly pointed, eliminating wasteful chewing up of lead. A turn of a ball-bearing indicator tap makes possible a point for every purpose including standard points, draftsmen's professional long-lead blunt or long-lead sharp points. Device is of convenient size small enough for pocket or purse, desk drawer, drafting table or school kit.—*Triple "E" Products Co., 4517 Olive St., St. Louis 8, Mo.*



LIGHTWEIGHT ROAD GRADER—Model 30 power maintenance is hydraulically controlled from operator's seat and features attachment which includes leaning front wheels, power broom, snow plow, bulldozer blade and scarifier. Operates five forward speeds ranging from 2.5 to 15.7 mph. and one reverse speed. Maximum blade pressure is approximately 5,000 lb. Equipment is built around a modified International power unit of 31.5 hp.—*Meili-Blumberg Corp., New Holstein, Wis.*

(*Continued on p. 94*)

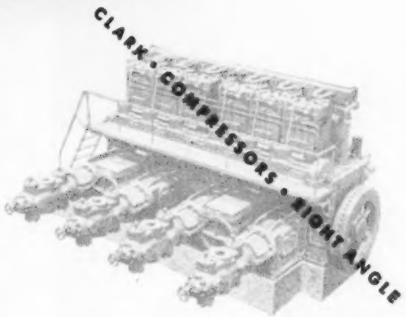
research in manufactured gas

ROOTS—CONNERSVILLE • ROTARY POSITIVE BLOWERS

CLARK • COMPRESSORS • HORIZONTAL ELECTRIC

STACEY BROS. • CONDENSERS

ROOTS—CONNERSVILLE • CENTRIFUGAL BLOWERS



CLARK • COMPRESSORS • RIGHT ANGLE

Where new means are being engineered for cheaper production of gas, the discoveries quickly filter down into the manufacturing divisions and show up in equipment.

Dresser Industries spans the whole gas industry. The several operating companies make blowers and compressors and scrubbers and multiple other components. But other members engineer sub-zero storage: coal conversion; low-cost, high-purity oxygen production.

Equipment from any of the companies is sold with engineering advice drawn from the over-all mass of group experience. Dresser Industries, Inc., grouped these companies together, with their overlapping varieties of similar-functioning equipment, to carry out a policy: that engineering need never be compromised for the sake of a sale.

DRESSER INDUSTRIES, INC.
TERMINAL TOWER • CLEVELAND 13, OHIO

Matched Equipment Matchless Service

BOVAIRD & SEYFANG Mfg. Co.
Bradford, Pa.

BRYANT Heater Company
Cleveland, Ohio; Tyler, Texas

CLARK Bros. Co., Inc.
Olean, New York

DAY & NIGHT Mfg. Co.
Monrovia, Calif.

DRESSER Mfg. Division
Bradford, Pa.

DRESSER Mfg. Company, Limited
Toronto, Ont., Canada

INTERNATIONAL Derrick & Equipment Co.
Beaumont & Dallas, Texas; Torrance, Calif.; Columbus, Marietta & Delaware, Ohio

KOBE, Inc.
Huntington Park, Calif.

PACIFIC Pumps, Inc.
Huntington Park, Calif.

PAYNE Furnace Co.
Beverly Hills, Calif.

ROOTS-CONNERSVILLE Blower Corp.
Connersville, Ind.

SECURITY Engineering Co., Inc.
Whittier, Calif.

STACEY BROS. Gas Construction Company
Cincinnati, Ohio
Stacey-Dresser Engineering Division
Cleveland, Ohio

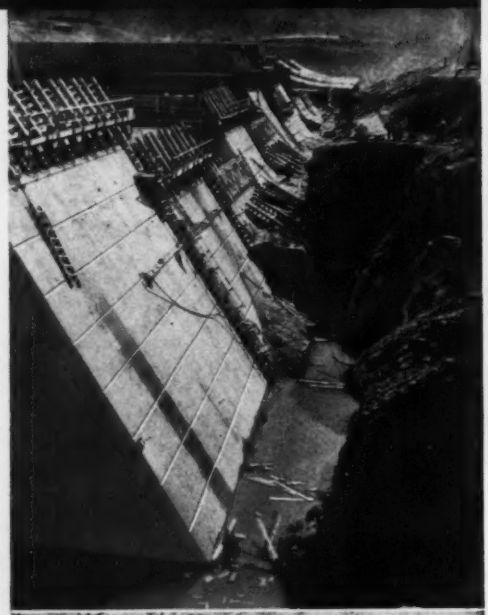
BLAW-KNOX

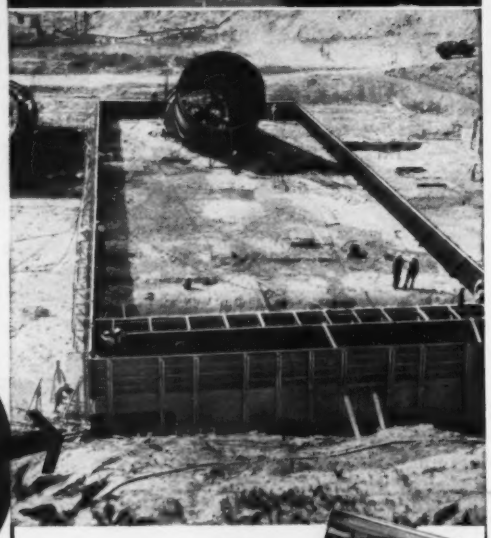
applies its STEEL FORM *"Know How"*

TO CONCRETE GRAVITY DAMS

Blaw-Knox has proved the practicability of its forming method for pouring concrete monoliths of gravity type dams—a design of steel form which is easily handled through successive lifts—and which can easily be aligned for all job conditions.

It would be our pleasure to tell you about this tried and proved system of BLAW-KNOX STEEL FORMS for concrete monoliths. You will incur no obligation by asking for this information.





This accurate alignment is quickly achieved by mechanized adjustment.

Blaw-Knox STEEL FORMS have been serving engineers and contractors for over 40 years. The Blaw-Knox record of accomplishment is shown in Catalog 1836. Send for a copy.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
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Birmingham • Chicago • New York • Philadelphia • Washington

BLAW-KNOX *has the* STEEL FORM "Know How"

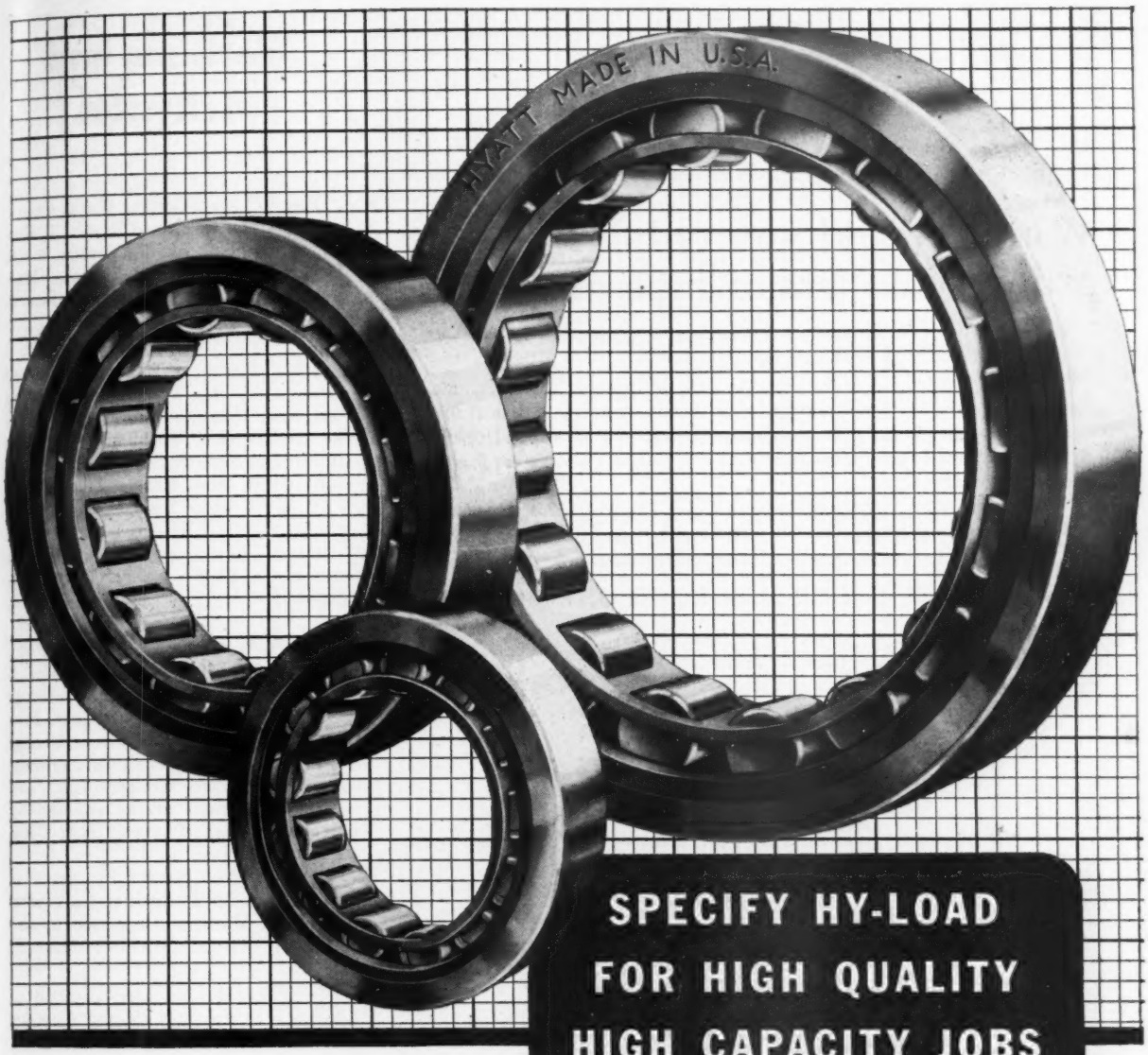
OVERBURDEN DRILL—A new 9-in. dia. rotary drill bit is useful for drilling overburden that contains hard shale or slate, limestone and some types of sand rock. The hard points of the bit cut three different paths to form a cutting or breaking pattern of three concentric rings in the bottom of the hole. The prongs of the bit are set 120 deg. apart and twisted at 15 deg. from vertical to accelerate the movement of cuttings away from the point and to provide a stronger edge to resist impact.—*Kennametal, Inc., Latrobe, Pa.*

TILE FASTENER—The Macco Chemical Co., newly formed in Cleveland, Ohio, has started production of a product called Macco Lastic, a plastic substance designed to secure wall and floor tile and also to be used as a base for terrazzo. It is said to be thinner and lighter in weight than most mastics and will not crack. Until a plant is located for the company, the product will be manufactured by — *The Special Chemicals Co., 1545 E. 18 St., Cleveland, Ohio.*

CURING BLANKET SPLICER—Machine pays out "Scotch" Wetordry tape as fast as man can walk, joining sheets of asphalt-impregnated paper into a single protective covering for curing fresh concrete. Tape sticks on contact as machine, weighing 33 lb., presses it tightly in place. When concrete has cured, tape can be stripped off easily permitting full width of protective paper to be reused repeatedly. Protective paper slows evaporation of water in concrete.—*Minnesota Mining & Mfg. Co.*, 900 *Fauquier Ave., St. Paul 6, Minn.*

HYDRAULIC-LIFT TAILGATE — One man can lower or raise pay load to or from ground. Capacity is 1,500 lb. Device, power operated, weighing only 733 lb. complete with all mounting parts, can be installed on any truck or semi-trailer body. Reduces need for loading docks and hazards involved in manual loading and unloading. Through convenient lever, operator has complete control of load on tailgate and can raise, lower, start or stop at any position between ground and truck bed level.—*Cemco Industries, Inc., Galion, Ohio.*

ALUMINUM TILE—Made in individual 4¼ in. squares, light and durable, Altico tile can be applied to ceilings and walls with mastic cement. Made in 16 popular colors. Foundation sheets are unnecessary. Tile is laid merely by pressing it into the mastic waterproofing cement. Tile may be cut or trimmed with ordinary household scissors.—*Alloy Tile Corp., Newark, N. J.*



SPECIFY HY-LOAD FOR HIGH QUALITY HIGH CAPACITY JOBS

HY-LOAD is an outstanding member of the Hyatt Roller Bearing family. Takes on tough loads without a murmur—rough service doesn't bother it a bit.

Universally useful because HY-LOAD is made in ten types and a wide range of sizes. A high quality roller bearing for high capacity work. Separate parts are completely interchangeable; adhering to AFBMA dimensions.

HY-LOADS, for years, have demonstrated their quality and trouble-free performance in many fields—mills and factories—on farms—oil fields—railways—highways and skyways. May we help you? Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

Insurance . . . and YOU

#8 of a series of informative articles on insurance and bonding.

Which would you rather lose—property dollars or income dollars?

If disaster shuts down your operations, you will suffer an income and a property loss. You need protection against *both!*

Property insurance alone won't protect you against loss of income, but Hartford's Business Interruption Insurance can do just that. If fire, storm, or other hazards insured against, force you to suspend operations, Business Interruption Insurance can protect you against loss of anticipated earnings.

Business Interruption Insurance can give you *just what your business itself* would have given you if no interruption had occurred.

Here, briefly, is how Business Interruption Insurance protects you:

BUSINESS BALANCE SHEET FOR ONE MONTH

Before Fire

Sales	$30,000
Cost of Merchandise	18,000
Gross Profits	$12,000
Expenses	10,000
Net Profit	$ 2,000

After Fire—WITHOUT Business Interruption Insurance

Sales	None
Cost of Merchandise	None
Gross Profit	None
Expenses continuing during shutdown	$ 7,000
Net Loss	$ 7,000
Add. Anticipated Profit Prevented	2,000
Total Loss	$ 9,000

After Fire—WITH Business Interruption Insurance

Sales	None
Cost of Merchandise	None
Gross Profit	None
Income from Business Interruption Insurance	$ 9,000
Expenses which continue	7,000
Net Profit	$ 2,000

(Same as was anticipated had no interruption occurred)

Hartford's Business Interruption Insurance is adaptable to almost any business enterprise; stores, factories, garages, theatres, hotels, etc.

The Hartfords have prepared work sheets to help determine how great a loss you might suffer and how much insurance you will need to safeguard your income. Write for them—there's no obligation!

HARTFORD

HARTFORD FIRE INSURANCE COMPANY
HARTFORD ACCIDENT AND INDEMNITY COMPANY
HARTFORD LIVE STOCK INSURANCE COMPANY

Writing practically all forms of insurance except personal life insurance
Hartford 15, Connecticut

Elections and Activities

The Wisconsin Sewage Works Operators' Association elected Harold T. Rutgal, superintendent of Kenosha Water Department president, Thomas Hay, Racine, vice-president and Theodore F. Wisniewski of Madison, secretary.

Louis Justement has been elected president of the Washington Building Congress. He is now working on plans for the proposed Washington Veterans Hospital and the Federal Courts Building. Other new officers elected are P. Y. K. Howat, of Howat Concrete Co., vice-president; William F. Nelson, masonry contractor, vice-president; and E. L. Davis, general contractor, director.

Leo B. Westfall, engineer with the Albany office of New York Power & Light Corporation, has been elected president of the Albany Chapter, New York State Society of Engineers. George A. Estabrook, Albany Felt Co. engineer, has been elected vice-president, and C. S. Christensen of the engineering department of the Power & Light Corp. is secretary-treasurer.

New directors elected for two-year terms are Arthur L. Bush, city engineer, and E. J. Burnham, engineer at the General Electric Co's Albany office.

Henri B. Vidal has been installed as president of the Erie County Chapter New York State Society of Professional Engineers. Other officers are: First vice-president, Elmer A. Hilburger; second vice-president, C. Arnold Dutton; corresponding secretary, John A. Beane; recording secretary, H. Dale Bossert; treasurer, Arthur B. Weaver, and directors, Edwin S. Bundy and George Steven.

New officers of the Engineers Club of Trenton, N. J., are: Joseph P. Clark, president; Hans Gartmann, first vice-president; Elliott F. Daniels, second vice president; Arthur D. Bullock, treasurer; Fred C. Claus, secretary.

The East Carolina Engineers Club was formed at a meeting at Wilson, N. C., May 26 with J. C. Gardner of Tarboro, retired division engineer for the North Carolina Highway Department, elected president. Kenneth Wright of Rocky Mount was elected vice-president, and W. J. Heard, city manager at Kinston, secretary-treasurer.

Rolling Steel Doors

Manually • Mechanically • Power Operated

Vertically opening Rolling Steel Doors offer many operating advantages in addition to providing greater protection and longer life. In Mahon Rolling Steel Doors you get all of these advantages plus a greater door value . . . this is immediately apparent if you check the details of construction, and the materials employed, against any other door of this type. You will find that Mahon Rolling Steel Doors are designed and built to give trouble-free service for a longer period of time. See Mahon Insert in Sweet's File for complete information, details and specifications.

THE R. C. MAHON COMPANY

Detroit 11, Michigan • Western Sales Division, Chicago 4, Illinois

Representatives in All Principal Cities

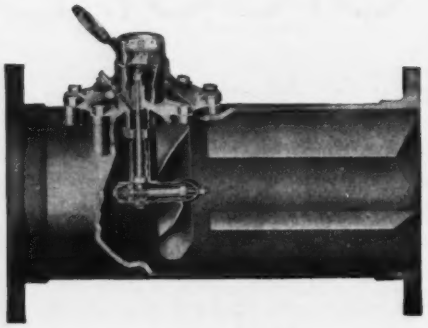
Manufacturers of Rolling Steel Doors, Grilles, and Underwriters' Labeled Rolling Steel Doors and Fire Shutters, and Mahon Steel Deck for Roofs, Sidewalls, Partitions, Acoustical Ceilings, Permanent Floor Forms.

One of Two Mahon Rolling Steel Doors Selected for Two Openings 30' x 30' in the General Electric Test Cell Building, Lynn, Mass. Turner Construction Company, General Contractors.

ROLLING STEEL DOORS, SHUTTERS AND GRILLES TO MEET EVERY REQUIREMENT

MAHON

SPARLING MAIN-LINE METERS



for
CONSISTENT ACCURACY

The above sectional view of the Sparling Meter shows the simple, direct action from propeller to totalizer.

Every Sparling Meter is guaranteed for accuracy within 2 per cent within the rated range.

Easily installed on all types of pump, reservoir and distribution mains, at moderate cost, they generally pay for themselves in reduced operating costs!

Bulletin 310 comes for the asking

J. W. SPARLING
Manufacturers of WATER MEASURING EQUIPMENT

LOS ANGELES 54..Box 3277 Terminal Annex — 622 Broadway.....CINCINNATI 2
CHICAGO 16.....3104 South Michigan Ave. — 101 Park Avenue.....NEW YORK 17
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MacArthur
38 YEARS INSTALLING PILES
OF EVERY TYPE

CAST-IN-PLACE CONCRETE COMPOSITE
STEEL SECTIONAL PIPE TIMBER
SOIL AND ROCK BORINGS

MacARTHUR CONCRETE PILE CORPORATION
18 EAST 48th STREET, NEW YORK 17, N. Y.
BOSTON • CINCINNATI • NEW ORLEANS

Manufacturers' Publications

Highway Shoulders—A 24-page illustrated booklet gives valuable data on highway shoulder improvement methods. It tells of traffic resistant turf shoulders and types of border strips or pavement edgings to carry part of the main traffic. The application of the Seaman Pulvi-Mixer in the construction of the various types is explained in text and illustrations.—*Seaman Motors, Inc., Milwaukee, Wis.*

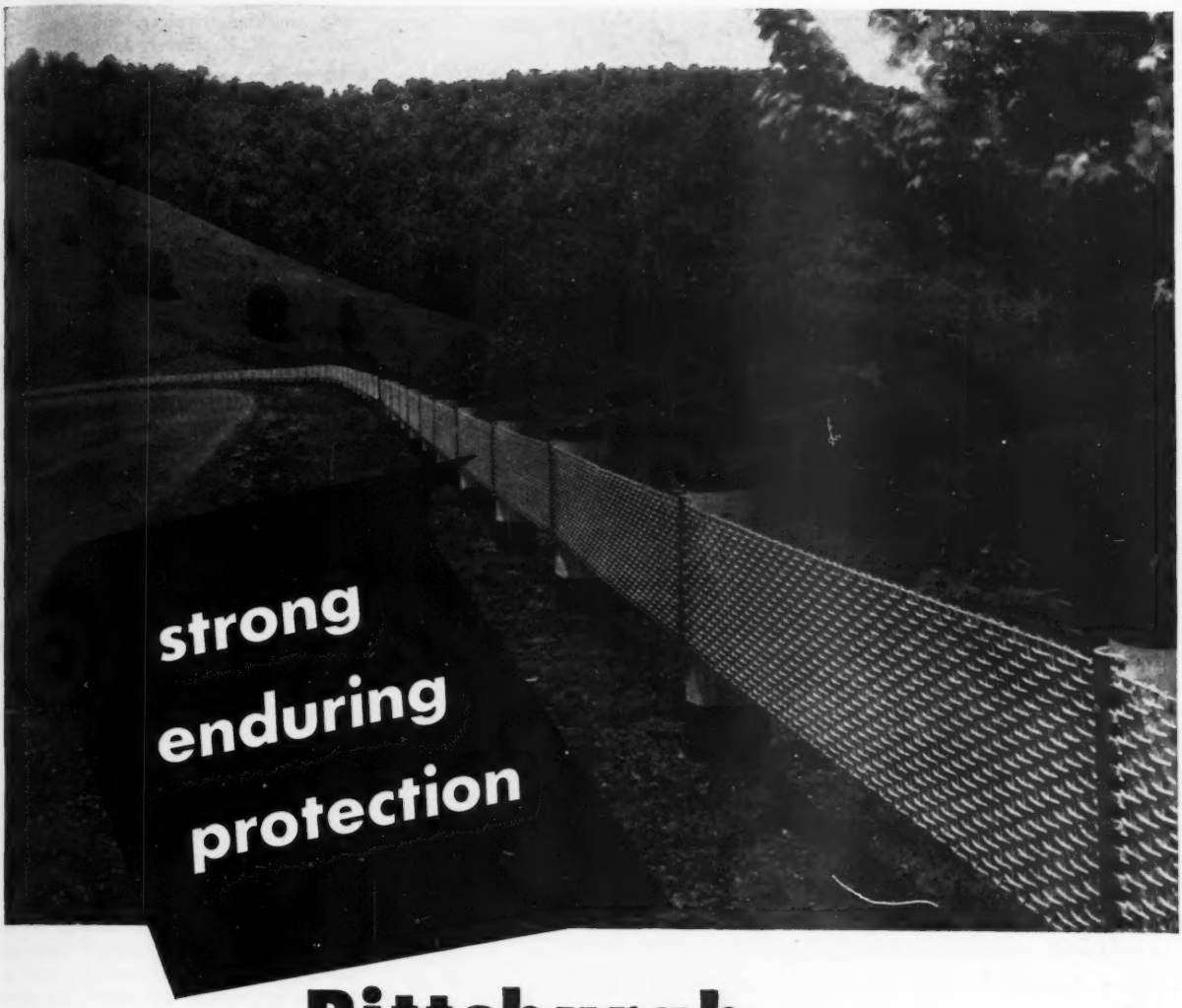
Crushing Power—This is the title of a catalog on roll crushers. Included are special tables showing how to get the most efficient roll crushing, complete specifications, maximum feed sizes, horsepower and capacity figures for each model.—*New Holland Machine Co., New Holland, Pa.*

Central Heating—A brochure gives a detailed account of how a group of cultural, educational and medical institutions cooperated to achieve a practical central heating system covering a wide area in the Oakland district of Pittsburgh, Pa. It is full of engineering data and technical information—*RiciL Co., Cleveland, Ohio.*

Subgrade—Booklet describes in the greatest detail a new precision subgrader that excavates subgrade by vibration. The advantages are that the mechanical removal of excess material from between the paving forms before the placing of the concrete pavement insures accurate control of slab thickness, low cost, uniform cross section, plenty of finished grade, and reduction of overrun of cement.—*Blaw-Knox Div. of Blaw-Knox Co., Pittsburgh, Pa.*

Fire Protection—"What You Should Know About Fire Extinguishers" is the title of a pocket size folder which is really a short course in first-aid fire protection. It points out that different types and sizes of fire extinguishers are required for different fire hazards, including ordinary combustibles, inflammable liquids, electrical equipment, etc.—*Pyrene Mfg. Co., Newark 8, N. J.*

Easy Power Cutters—A little folder about Porter cutters points out the amazing fact that 50 lb. pressure at the handles delivers 4,000 lb. of pressure at the cutting edge. This hand-operated tool cuts bolts and screws, concrete reinforcing and other rods and form wires. Special purpose tools are used for punching, crimping, pressing, head-



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Not only is an attendant unnecessary—boiler-room and ductwork expense was eliminated, too, by installation of a Dravo *Counterflo* Heater. Centered along the east wall, the Dravo *Counterflo* Heater is entirely self-contained—requiring only power and fuel lines and a small vent stack. Its 1,000,000 BTU output is directed slightly over the heads of the workers to blanket 10,000 square feet of unbroken plant area with draft-free warm air. Cold corners and excessive roof heat loss are eliminated. During summer months, a touch of the selector switch converts the Dravo *Counterflo* Heater immediately into a powerful air-circulating unit.

Dravo *Counterflo* Heaters are available in sizes ranging from 400,000 to 2,000,000 BTU output. Equally efficient with oil or gas and with or without ductwork, they can be floor-installed, wall-hung or roof-hung. Write for Bulletin HW-516. Heating Section, Dravo Corporation, Dravo Building, Pittsburgh 22, Pennsylvania.

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According to Mr. Schulman, President of Sanatex Company, the Dravo *Counterflo* Heater "is the best equipment we ever had. Delivery of heat is virtually instantaneous when the unit goes into action—an important fuel-saving feature which eliminates the need for anticipating cold spells or keeping the heater in operation when the plant is closed."

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ing, caulking, riveting, and seam flattening.—*H. K. Porter, Inc., Somerville 43, Mass.*

Purolators—Booklets have been issued on puralators for general industrial and machine tools and for diesel engines. Full technical details are given in each case as to uses and applications. —*Purolator Products, Inc., Newark 2, N. J.*

Gauges for Water Works—A bulletin covers mechanically-operated gauges for water filtration plants, where it is necessary to measure levels and heads, to meter and control flow rates automatically, and to report these functions continuously by suitable instruments. The bulletin calls special attention to the advantages of the diaphragm pendulum units—powerful actuation, immunity from damage due to reverse differential, freedom from loss of mercury, flexibility of installation, and independence of negative heads. A feature is the description of custom-built gauges of special design and finish to harmonize with plant design and color scheme. —*Builders-Providence, Inc., Providence 1, R. I.*

Water and Acid-proof Film—A bulletin gives facts concerning "Eternacote" a transparent liquid organic chemical compound of a pure rubber base and plasticising resins in an aromatic solvent which, when used on concrete, natural or cast stone, wood, stucco, brick or concrete block, concrete pipe, plaster or wall board, is said to form a permanent waterproof and acid proof film. The manufacturer says it is especially useful for health and sanitation departments, low-cost housing, and the chemical, steel and petroleum industries.—*George H. Hoffman Corp., 121 Broad St., New York 4, N. Y.*

Industrial Pumps—A 36-page catalog affords complete information in regard to recent developments in horizontal and vertical shaft centrifugal pumps for such applications as pumping corrosive or hot liquids and abrasive or heavily laden mixtures. Two horizontal shaft and three vertical shaft types of pumps are illustrated and described as are also some special types. The five classes of Nagle impellers are shown.—*Nagle Pumps, Chicago Heights, Ill.*

Bucket Loader—A 4-page folder tells of the K-5 bucket loader built for dependable service wherever loose materials such as earth, gravel or broken stone up to 2½ in. size is to be loaded from the ground into trucks. Moving by its own power for shorter distances and arranged for towing over the longer runs, it is well adapted to road mainte-

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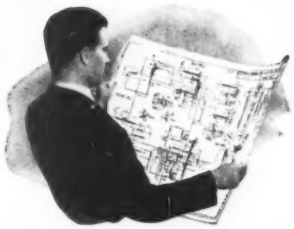

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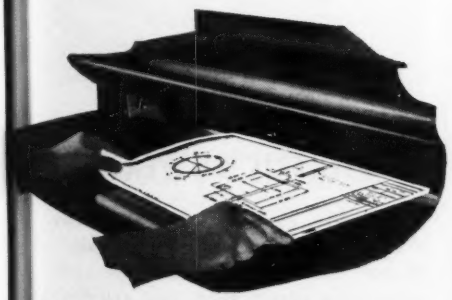

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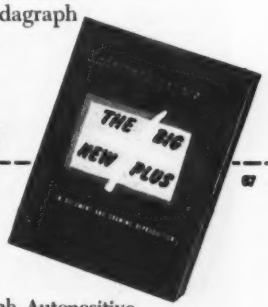

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nance and borrow-pit work as well as for stockpile service. One-man operation; 27 hp. engine; separate twin disc clutches; powerful feeder spirals pick before they shovel; discharge chute, turned from the platform, avoids spill at the truck.—*N. P. Nelson Iron Works, Inc., Clifton, N. J.*

Floor and Surface Armors—A 20-page technical manual describes the uses and installation of floor and surface armors. These open mesh steel grids are imbedded in concrete, mastic or asphalt to protect and re-inforce the road surfaces of bridges, docks, wharves, landing strips, loading ramps, heavy industrial floors, etc. The manual explains how to lay either Hexteel or Floorsteel in new concrete, over wooden floors, or old concrete or mastic. It also explains recommended fills, and how to repair broken or crumbling floors with the steel armors. Hexteel comes in standard slabs 3x10 ft. Floorsteel is a flexible floor armor that rolls out like a rug and is particularly useful over ramps or uneven surfaces.—*William F. Klemp Co., 6,601 South Melvina Ave., Chicago 38, Ill.*

Concrete Cutter—(leaflet). Equipped with diamond saw blade, portable machine is mounted on wheels and powered by 6-hp. engine, weighs 395 lb. Stratedge machine cuts concrete from depths of from 1 to 3 in. Manufacturer recommends it in operations of tearing up and replacing sections of floor surfaces in buildings. Simple gage controls depth of cut. Blade is water cooled. —*Backlin Products Corp., 461 Washington St., Burlington, Wis.*

Pallet Handling—A 20-page bulletin covers pallet system applications, hand lift and Worksaver pallet truck models, and recommended pallet design. It is of special interest since such systems have been found to cut costs of receiving, warehousing, shipping and internal transportation costs. The Worksaver is a truck guided by hand and powered by battery for lifting and moving.—The *Yale and Towne Mfg. Co., Philadelphia Div., Philadelphia, Pa.*

Power Hoe—A non-tilting plaster and mortar mixer for which large daily yardage is claimed is described in a 4-page folder. It is a frameless, one-bag mixer that saves on time, work, materials and weight. Its body, made of high-strength rust and corrosion-resisting steel, electric-welded into a rigid, one-piece semi-cylinder of great strength, serves as both body and frame. It has a criss-cross mixing action that produces a strong, even-tempered mix which lays up fast and easily.—*The Jaeger Machine Co., Columbus 16, Ohio.*

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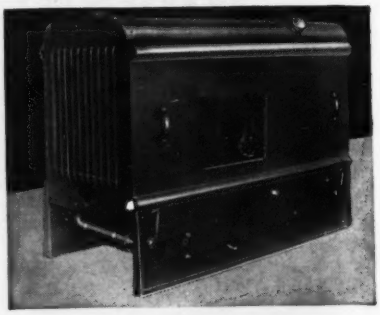

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Men and Jobs

William S. Moore, South Bend, Ind., has been named to a four year term on the State Board of Professional Engineers and Land Surveyors.

Lt. Col. William J. Ellison, Jr., has been named head of the McNary Dam division, activated within the Portland, Ore., District Corps of Engineers. It will have three branches: Townsite, with **John R. Thatcher** as chief; construction, headed by **William B. Watson**; and engineering, headed by **Alton G. Davis.**

William O. Owen has resigned as city engineer of Centralia, Mo. He is to be succeeded by **Frank Manglesdorf,** who is to have the title of city manager and coordinator.

Shortridge Hardesty has been commissioned to make preliminary sketches and cost estimates for a new span over the Maumee River in South Toledo, Ohio.

Frederick H. Warren has been appointed to the job of chief of the engineering-construction branch of the Atomic Energy Commission. **Kirby K. Wyatt,** former chief of the branch, will remain on the engineering staff in an advisory capacity.

Stanford E. Harris of Lenoir, N. C., has been named superintendent of the municipal water system at Goldsboro, N. C.

E. F. Eldridge, of Michigan State College, has been retained for a period of four months by the Washington State Pollution Control Commission.

Frank J. Raschig, consulting engineer to the Ohio Director of Public Works, **George B. Sowers,** retired recently. As director of public works from 1940 to 1947, he supervised work including the Lake Erie beach erosion projects.

Davis A. Day, civil engineer associated with the General Paving Co., Champaign, Ill., has been appointed to the civil engineering faculty of the University of Illinois.

A. O. Hastings has been advanced from his position as district engineer to the post of superintendent of maintenance for the Indiana State Highway Commission. **William R. Campbell** will temporarily fill the post vacated by Mr. Hastings.

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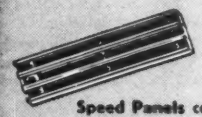

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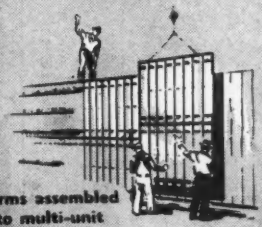

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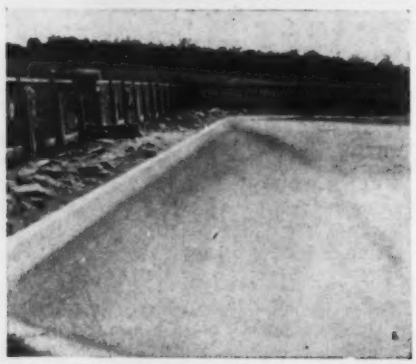

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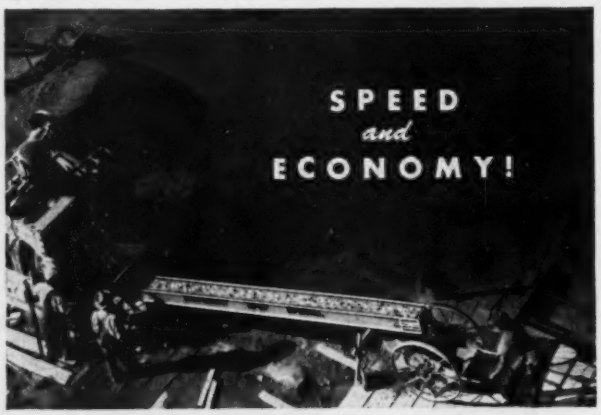

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Manufacturers' Activities

Current developments among manufacturers relating to expansion of services, shifts in personnel, and other changes, include the following:

Sales—Harry C. Williams is general sales manager of THE H. K. FERGUSON Co., Cleveland, Ohio. . . . C. B. Murphy will be sales representative of LIMA-HAMILTON CORP. in the Southwest. . . . M. H. Kirkeby, 437 Oliver St. South, Minneapolis 5, Minn., is sales representative of Alpha Metals, Inc., of Brooklyn, N. Y., in Minnesota and North and South Dakota. . . . NORTHWEST ENGINEERING Co. has appointed F. A. Stoughton, 487 McCully St., Pittsburgh 16, Pa., as district sales manager in the Pittsburgh area. . . . R. R. Schultz has been promoted from assistant to sales manager of the crusher and process machinery divisions of NORDBERG MFG. Co. Milwaukee, Wis. . . . George Harshberger has been made vice-president in charge of sales for the CALRESIN CORP., Culver City, Calif. . . . Howard Mareton, sales and service engineer at the Boston, Mass., branch of MINNEAPOLIS-HONEYWELL REGULATOR Co. is now industrial manager of the BROWN division at Minneapolis and St. Paul, Minn.

Distributors—WILSON C. BLAKE Co., 190 Beacon St., Hartford, Conn., is distributor of DRAVO "Counterflo" heaters in Connecticut and Western Massachusetts. . . . T. SOUTHWORTH TRACTOR & MACHINERY Co., INC., Menands, N. Y., is distributor for Humdinger pumps for RALPH B. CARTER Co. in several counties in northeastern New York and in Bennington County, Vt. . . . NEVADA EQUIPMENT SERVICE, INC., Reno, Nev., is appointed BUCYRUS-ERIE distributor in parts of Nevada and California. . . . EARLE EQUIPMENT Co., Detroit, Mich., is distributor of GENERAL MOTORS series 71 diesel engines.

Personalities—Edmund B. Besselievre is now in charge of all sanitary engineering work for the foreign division of THE DORR Co., 570 Lexington Ave., New York 22, N. Y. . . . THE GORMAN-RUPP Co., Mansfield, Ohio, has announced the appointment of Walter O. Duehler as vice-president in charge of engineering and for the design and engineering development of a complete new line of standard centrifugal pumps for industrial and municipal use.

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